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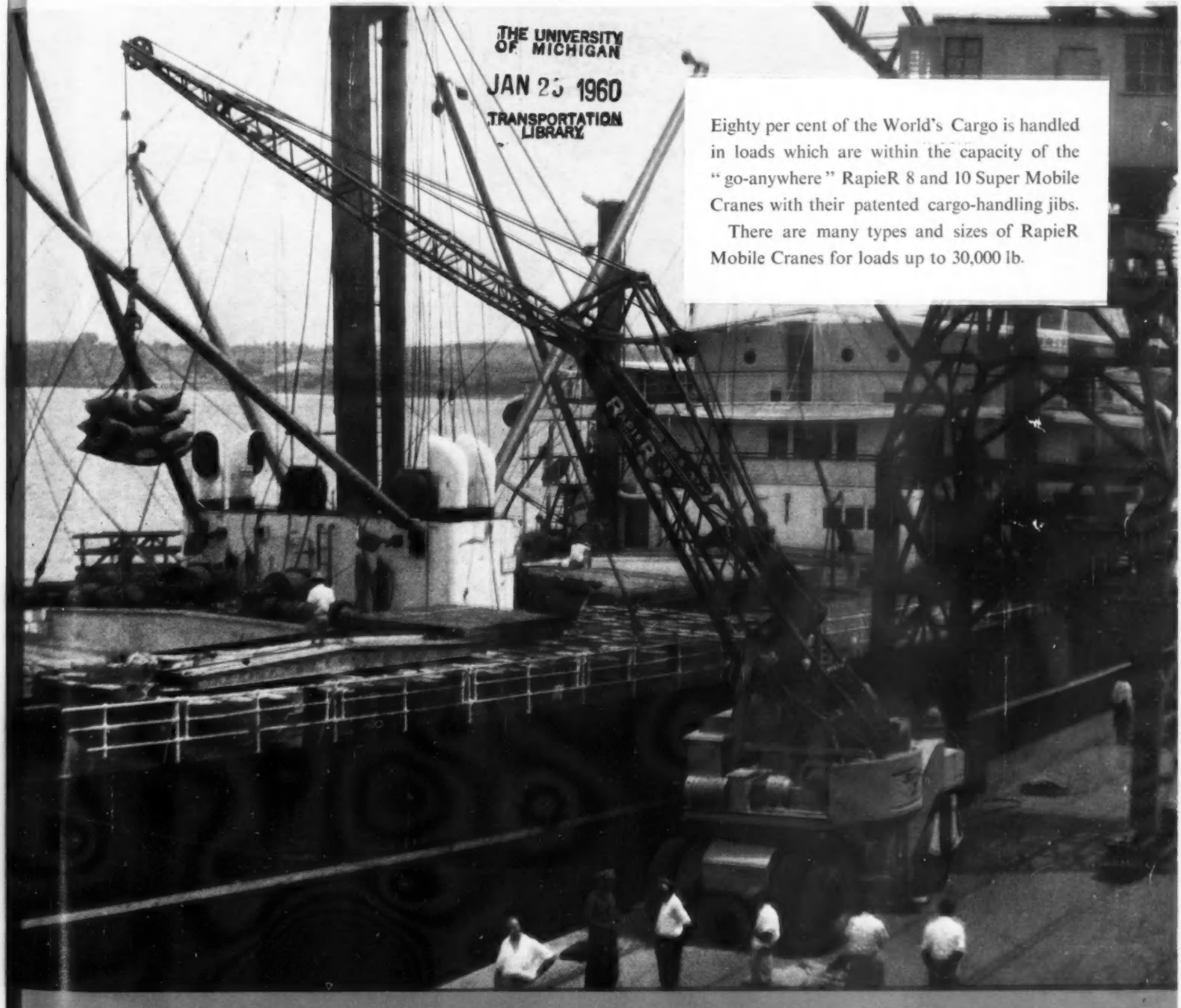

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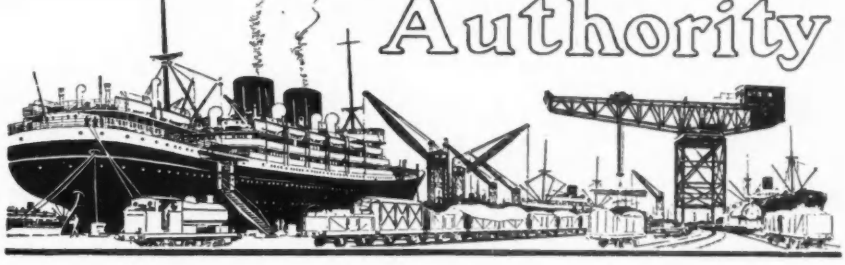

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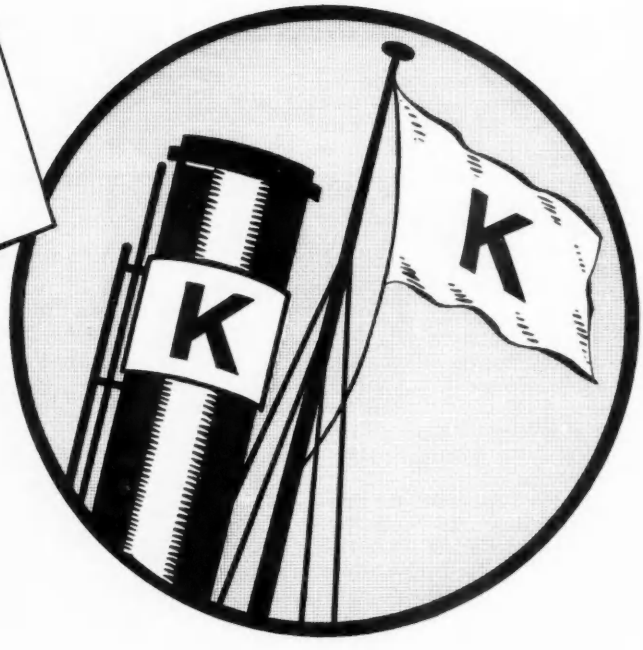

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The Dock & Harbour Authority

An International Journal with a circulation extending to 85 Maritime Countries

No. 470

Vol. XL

DECEMBER, 1959

Monthly 2s. 6d.

Editorial

Seasonal Greetings

The Editor and Staff of "The Dock & Harbour Authority" take this opportunity to send Christmas Greetings to all readers of the Journal and to wish them a Prosperous New Year.

The Port of Wilhelmshaven

Situated on the west side of the entrance to Jade Bay on the coast of Lower Saxony, the port and town of Wilhelmshaven, since the middle of the 19th century, derived its importance from its activities as the chief German naval station on the North Sea. Port construction works were started in 1854 and the harbour was opened to shipping in 1869. The industrial development of the town was almost entirely dependent upon supplying the needs of the dockyards and its commerce was largely confined to importing coal, liquid fuel and raw materials for naval construction.

During the Second World War, Wilhelmshaven was extensively damaged by Allied bombing and, following the defeat of Germany, all naval installations and port facilities were completely destroyed. The municipal authorities were therefore faced with serious unemployment and the difficult problem of restoring industrial activity.

An account of the impressive economic recovery which has been achieved during the last decade and, more particularly, a description of the construction of the new oil jetty and ancillary facilities forms our leading article for this issue.

Simplification of Shipping Documents

The volume and complexity of documentation required of vessels in every major port of the world is a problem well known to the shipping industry and port authorities. Simplification of this time-consuming and expensive aspect of maritime commerce has long been desired and, during recent months, a number of countries have initiated enquiries into ways of effecting an improvement.

In particular, the International Chamber of Shipping at its annual meeting in April last " noting the staggering extent of the paper work now required from merchant ships and the lack of international uniformity," decided to set up a sub-committee to examine what progress towards revision has already been made in different countries and to recommend how best the I.C.S. could act to bring about the improvements so urgently needed.

At their first meeting, held last October, the sub-committee considered results of studies made in Belgium, Denmark, the United Kingdom, Holland, Sweden and the United States and decided on the steps to be taken to secure further facts and information from other areas. It felt that " while there was a growing need for international understanding and action to secure uniformity and simplification in ship documentation, the immediate need was for a review nationally of the requirements of different countries by governmental authorities and shipping interests." It also agreed that the first step to be taken was to complete the factual surveys which have been started and to promote international discussions.

The difficulties are complex and to find a solution which will be accepted by all nations will take time and patience. Our readers will be interested in a review of the problem on page 243 of this issue, and next month we hope to publish abstracts from a Paper presented in Copenhagen recently which deals with the problem of multitudinous paper work as it affects port administration.

Bi-Centenary of the Port of Glasgow

Two hundred years ago the first Act of Parliament was obtained for the improvement of the River Clyde and throughout two centuries of progress the Port of Glasgow has emerged as one of the principal ports of the United Kingdom. To mark the occasion we are publishing in this issue a review of the development of the port from its early beginnings to the present day.

It was early in the 17th century that influential members of the trading community of the Burgh of Glasgow advocated the removal of the sandbanks and shoals in the river in order to provide a navigable channel to enable the small vessels of that time to make passage to and from the town. In 1636, Charles I granted a Charter to the free burgh, giving rights to deepen the river and build ports, but apparently little definite progress was made until the Act of 1759 which gave the Provost and Magistrates of Glasgow increased authority to effect improvements.

In the ensuing years further legislation was approved by Parliament, the most important being the Act of 1858 which transferred the administration of the river and harbour to the jurisdiction of the Clyde Navigation Trust as now constituted.

Since that time the Port of Glasgow has evolved to its present influential position on the west coast of Scotland. Over 12 miles of quays have been constructed with deep water berthage for all classes of ships, and ample accommodation and modern equipment has been provided for the handling of cargo of all kinds.

Further development plans are in hand and the progressive policy of the Trustees should assure the port of a prosperous future.

Topical Notes

Scheme for Dock Workers in Port Cochin

A scheme to regulate the employment of dock workers, similar to the schemes already in force in the ports of Bombay, Calcutta and Madras, is to be introduced in the Port of Cochin in south east India.

Under the scheme the Central Government will constitute a tripartite dock labour board which will be responsible for its administration. The dock workers are to be divided into two classes, monthly workers and casual workers, generally known as reserve pool workers. As the latter are not assured of regular employment, they are to be registered in a pool under the jurisdiction of the Dock Labour Board and guaranteed a minimum wage for twenty-one days each month. They will receive an attendance allowance of Rs. 1-8-0 per day on the days when work is not available and also will be entitled to "disappointment" money at half the wage if work which has been booked is interrupted or cannot be started. They will be entitled to eight days' holiday with pay a year and will be engaged in rotation so as to ensure equal opportunities of employment.

Joint Labour Council for Port Swettenham

The Harbour Trade Union of Port Swettenham, Malaya, and three of the main stevedore employers have recently signed a memorandum of agreement establishing a Port Transport Industry Joint Council to provide a constitutional means of consultation and negotiation between the union, representing some 3,000 dock workers, and the licensed employers. The Council will consist of twenty members, ten from each side, and two joint secretaries who will be ex-officio members without voting rights.

The main functions of the Council will be to negotiate agreements covering hours of work, rates of pay and conditions of employment; to provide a medium for consultation between the parties on matters of mutual interest; and to discuss ways and means of achieving a faster turnround of shipping by the most efficient use of the labour force.

New Labour Contract for U.S. Dockers

The United States International Longshoremen's Association recently announced in New York that its members from Maine to Virginia on the east coast of America, have approved a new three-year labour contract. The agreement (approved by a vote of about four to one) ended the threat of a renewal of the dock strike at North Atlantic ports.

The new agreement calls for a 12-cent increase the first year to bring the dockers' basic wages to $2.92 an hour, an additional five cents an hour the second year and five cents an hour more in the third year. The companies will also contribute seven cents an hour to the pension fund and four cents more to the welfare fund. The rest of the agreement covers other workers' benefits, three more paid holidays—bringing the total to eight a year, and more liberal holidays in the second and third year of the contract.

It will be recalled that more than 70,000 dockers at ports along the east and Gulf coasts staged an eight-day strike in October that tied up shipping and left cargoes standing in many ports throughout the U.S.A. The main issue in the dispute was the shipping companies' desire to introduce more mechanical aids on the docks for unloading ships' cargoes.

Proposed Second Shipyard for India

The second shipbuilding yard proposed to be established by the Government of India, will be located in Cochin. An order has been issued to acquire about 75 acres of land, which will be in addition to the 30 acres of reclaimed Government land transferred for the purpose.

The British mission, which visited India some years ago and recommended the site, estimated that it would take about three years to construct and bring into use a complete shipbuilding yard including drydock and repair facilities. The cost of the new yard is estimated at Rs. 191,600,000 (over £14 million) excluding the cost of the site and of such items as railway extensions and road links. The cost of equipment from abroad is expected to be about £2 million.

Commenting on the delay in implementing the British mission's report, "The Hindu" of Madras has stated: "It is not difficult to understand the reasons for the rather tardy manner in which the Government have been dealing with the British mission's report. Their experience with the shipbuilding yard at Vizagapatam has been none too happy or encouraging. Not only have the cost of ships built there been substantially higher than the price at which they could be purchased abroad, but some of the ships coming out of the Vizagapatam yard have not proved satisfactory."

Speaking at a function held in Cochin recently, however, the Minister for Shipping, said that both the private and public sectors in the Indian shipping industry had come up to their expectations in reaching the target of 500,000 gross tons during the first Five-Year Plan and 900,000 tons during the second Five-Year Plan. He also suggested the building of small vessels which could make regular and scheduled visits to minor ports and so help in their development.

Deepening of the Suez Canal

Speaking to members of the shipping and oil industry at a luncheon given recently by the American Eastern Corporation, the chairman of the Suez Canal Authority stated that the canal is to be deepened to accommodate larger tankers. During the past 3 years the canal has been deepened to 35-ft. for the transit of oil tankers and dredging will continue until, by late 1960, the expected permissible draft will be 37-ft.

According to the latest annual report, 1958 was a year of record operations. Two large tugs, each of 6,000 h.p. have been purchased and will be used to assist any ship that runs aground during transit; 233 pilots are now employed and a programme is in hand training men for the gradual replacement of all foreign pilots when contracts now operating expire about 1968; a drydock at Port Said with a lifting capacity of 25,000 tons is also planned.

The U.S. Army Corps of Engineers' dredger "Essayons" has now returned to New York after some months service in the canal.

VIIth Conference on Coastal Engineering

The 7th Conference on Coastal Engineering will be held from August 22nd to 27th, 1960 at the Kurhaus at Scheveningen, The Hague, Netherlands.

At these conferences the following problems are discussed. Methods of engineering activities on the coast, such as the growth and behaviour of waves, tides and storm surges; formation and erosion of coasts; coastal protection and flood prevention; design, construction and maintenance of harbours etc., and instruments for and methods of investigation.

During the meeting visits will be arranged to the Delta Works, the Zuiderzee Works and the Hydraulic Laboratory.

The conference is sponsored jointly by the Council on Wave Research of the Engineering Foundation (U.S.A.) and the Rijkswaterstaat.

Those willing to contribute a paper are requested to communicate the title and a short abstract of the content to one of the following addresses. Prof. J. W. Johnson, University of California Engineering Field Station, Building 159, Richmond 4, California, or to J. B. Schijf, Koningskade 25, The Hague, Netherlands.

The Oil Port of Wilhelmshaven

Post-War Industrial Development

(Specially Contributed)

Economic Development

WILHELMSHAVEN was founded about a hundred years ago as a naval base, and until the end of the Second World War this was virtually its only function. Thus in 1939 some 65 per cent of all persons earning a livelihood in the town were employed by public authorities, while only 13 per cent were engaged in trades or industry. There were no large or medium-sized industrial undertakings at all, and such commercial establishments as did exist were mainly suppliers to the German navy. Indeed, no other town in the whole of Germany presented so lop-sided an economic pattern as did Wilhelmshaven.

When under the terms of the Treaty of Versailles, after the First World War, Germany was compelled to effect a drastic reduction of her naval forces, Wilhelmshaven had to pay the price for its one-sided development. For years its unemployment figures were relatively the highest in the country. It was not until 1935, when schemes for the rehabilitation and expansion of the German navy were put in hand, that some measure of prosperity was restored.

The defeat of Germany in 1945 appeared to spell the final doom of Wilhelmshaven. The Allies initially intended to eradicate the town by blowing up the sea locks and thus flooding the whole central area (at present inhabited by upwards of 75,000 people). This drastic plan, which would have involved large-scale resettlement of the population elsewhere, was eventually abandoned. All naval installations—including the entire port facilities—were very thoroughly destroyed, however. Thus, at one blow, the town was deprived of almost its only means of livelihood.

Wilhelmshaven owed its subsequent survival as an economic entity mainly to two facts. In the first place, the many thousands of unemployed naval dockyard personnel constituted a rich reservoir of skilled metal-workers and artificers. The other important factor which enabled the town to win its post-war struggle for existence was the mass exodus of firms and industrial undertakings of all kinds from the Soviet-occupied zone of Germany. The municipal authorities of Wilhelmshaven were quick to realise the advantages that could accrue to their town from this trend of events. They opened negotiations with a number of these firms and gave them every encouragement to establish their headquarters and factories at Wilhelmshaven. Since 1946, upwards of a hundred industrial undertakings have thus become integrated into the town and form the backbone of its economy. At the end of 1958 they were employing a total of over 24,000 persons—more than double the peace-time personnel of the former naval dockyard.

The nucleus of this new industrial development is formed by light and heavy engineering works of various kinds, comprising some 16,000 employees and manufacturing a wide range of products (typewriters, drawing office equipment, mechanical handling plant, textile machinery, structural steelwork, shipbuilding, foundry products, etc.). In addition, several textile mills—now employing some 4,000 workers — and a number of small and medium-sized concerns turning out wood, leather, glass and plastic goods were established at Wilhelmshaven. In the years that have elapsed since the end of the Second World War, the town has thus developed into the largest industrial centre between the Weser and the Ems.

In recent years, by a twist of fate, Wilhelmshaven has once again become a naval base. This has further helped to consolidate the town's economy. On completion of the current rehabilitation schemes, Wilhelmshaven will have a naval establishment of some 5,000 personnel.

Future Trends

The return of the German navy to Wilhelmshaven is welcomed not merely on account of the additional employment and prosperity it will produce as a direct consequence, but also because it will entail the reinstatement of the dock and harbour facilities, which in turn opens up the prospect of utilising and developing a substantial section of the port for commercial purposes.

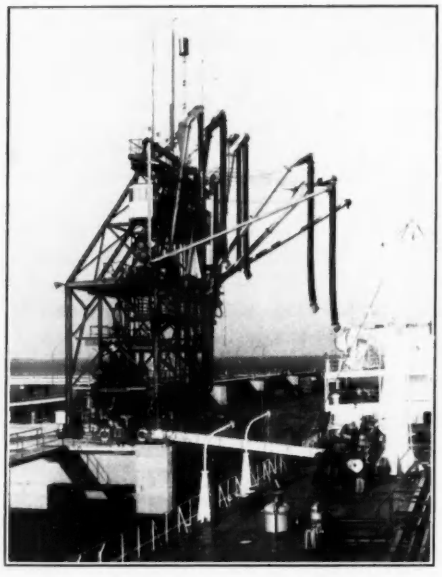
Wilhelmshaven is admirably suited for expansion as a port, especially for the handling of bulk commodities. It is one of the most favourably situated of all ports in Northern Europe in possessing a harbour which surpasses that of almost every other maritime city in respect of depth, freedom from fog and ice, operating costs, and scope for future development. Not the least important factor in this connection is that the Nord-West-Oelleitung GmbH, a joint undertaking set up by a number of major oil companies, has selected Wilhelmshaven as the starting point for a long-distance oil pipeline to the Ruhr District. Under this scheme the port is being equipped with the necessary oil unloading, handling and storage facilities.

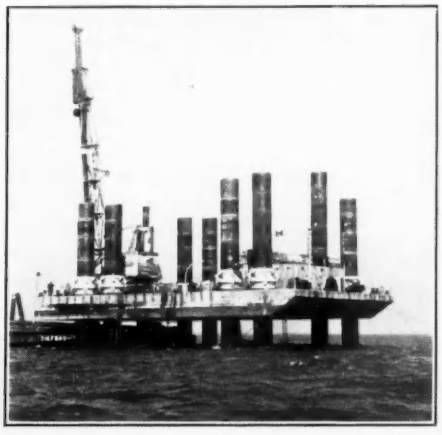
At the end of November 1958 the oil harbour of Wilhelmshaven was put into operation. Since that time upwards of a million tons of crude oil have been discharged at the port. It is fairly certain that in a few years' time the Ruhr pipeline will be operating at its full capacity of 22-23 million tons of oil per year.

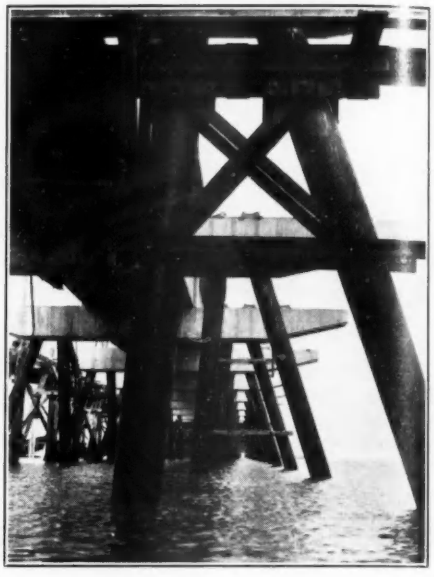
Wilhelmshaven has an advantage over most other oil ports in that it lies on an excellent waterway navigable by even the largest super-tankers. With the continued expansion of world trade and the increasing volume of imports into Europe, a solution for the problem of effecting reductions in freight costs will have to be sought in the use of larger vessels of increased draught. From this point of view, too, Wilhelmshaven with its deep-water port facilities is undoubtedly at a considerable advantage.

The trend towards the use of increasingly large ships, which first manifested itself in oil-tanker construction, has in recent years spread to ore-carrying vessels. It is anticipated that by the end of 1961 at least a third of the total ore-carrying tonnage will be constituted by vessels of over 30,000 tons, and the proportion of vessels in the 50,000-ton-and-upwards class in this branch of maritime trade is increasing from year to year. Indeed, of all Continental ports on the North Sea, only Wilhelmshaven and Rotterdam are capable of accommodating vessels of such size.

The volume of trade handled by the Port of Rotterdam has undergone, and is still undergoing, a spectacular expansion. But there is a natural limit to the capacity of any port, and it is therefore essential to provide alternative port facilities in order to keep pace with the growing needs of commerce and industry. It is considered that Wilhelmshaven, with its excellent "strategic" situation in relation to the industrial districts of the Ruhr and







Left: Hose handling frame. Two of the hoses are being lowered into position for coupling to the tanker.

Above: De Long piling island in operation.

Right: Piles under the approach structure.

Rhineland, is in an exceptionally favourable position to benefit by this trend of development.

A further reason for believing that Wilhelmshaven will, in course of time, play a major part as a bulk cargo handling port is that its main future extension will be in the form of an outer harbour, i.e., providing berthing accommodation outside the navigation locks giving access to and from the present port facilities. Suitable areas of land situated alongside deep water are available for such extension. The more the vessels using the port increase in size, the more imperative will it become to cut down turn-round times in order to reduce costs. At Wilhelmshaven, thanks to the ample width and depth of the bay on which it lies, vessels entering and leaving the port will not have to navigate relatively narrow channels and will therefore not be subject to speed restrictions such as those which obtain at most other ports. Hence it will be possible to effect substantial savings in time.

The New Oil Port

The total West-German consumption of petroleum products in 1957 was about 17 million tons. This figure is expected to increase to about 26 million tons by 1960 and to about 39 million tons by 1966. The greater part of the crude oil required has to be imported by sea. In November 1956 a company under the style of Nord-West-Oelleitung GmbH was forced with the object of promoting the construction of a pipeline for the conveyance of crude oil from the North Sea coast to the Ruhr District. Six major oil companies participated in the undertaking. Wilhelmshaven was selected as the most suitable starting point for the proposed pipeline, as this port offered the necessary potentialities for development into a deep-water oil port capable of accommodating even the largest tankers, besides being so situated in relation to the Ruhr District that the cost of constructing the pipeline and bringing the oil to its destination would not be prohibitively high. The new oil port was sited north of the town.

The 70 cm. diameter pipeline starting at Wilhelmshaven has an overall length of some 390 kilometres, including the various branch connections. In the initial stage of its operation it is provided with only one pumping station (at Wilhelmshaven) and is capable of conveying 9 million tons of crude oil per year. The subsequent construction of three more pumping stations will increase the capacity of the pipeline to upwards of 20 million tons per year.

A system of storage tanks serves as a balancing reservoir between the intermittent deliveries of oil by the tankers and the continuous discharge of oil through the pipeline. In the first stage of the oil port development scheme 14 crude-oil tanks of 55 m. diameter and 13 m. height, with a total capacity of 440,000 m^3, have been provided.

It is estimated that in the initial phases of operating the pipeline—which was put into service in December 1958—the oil port will handle some 300 tankers a year and that this figure will subsequently rise to over 700, including tankers of up to 100,000 tons deadweight.

The oil jetty has been constructed initially as an L-shaped structure to provide berthing accommodation for three large tankers and will at a future time be extended to form a T-headed structure capable of accommodating six tankers. Additional berths for smaller vessels can be provided by building secondary finger piers between the jetty head and the shore.

Design Features

As a preliminary to the design of the jetty, exhaustive current surveys and hydraulic model tests were made by the Franzius Institute of the Technological University of Hanover. Soil explorations were also carried out. The sea bed was found to consist of a layer of gravel overlying fine sand deposits. Removal of the protective gravel would cause disturbance of this sand by the tidal currents and thus give rise to serious scour phenomena. On the basis of technical, operational and economic considerations it was decided that the most suitable form of construction for the jetty would be an open type structure carried on relatively slender piles. These would, however, have to possess sufficient strength to withstand the impact blows from drifting ice, besides being able to resist the normal loads due to dead weight, superimposed and live load, wind pressure and current pressure. To facilitate the berthing of the tankers it was desirable that the jetty head should be built parallel to the direction of the prevailing current and be sufficiently far out into the water to provide a natural depth of about 15 m. below mean low water level, inasmuch as it was essential to avoid any major dredging operations liable to have an adverse effect on the stability of the sea bed. For this reason a length of nearly 700 m. had to be adopted for the approach structure giving access to the jetty head.

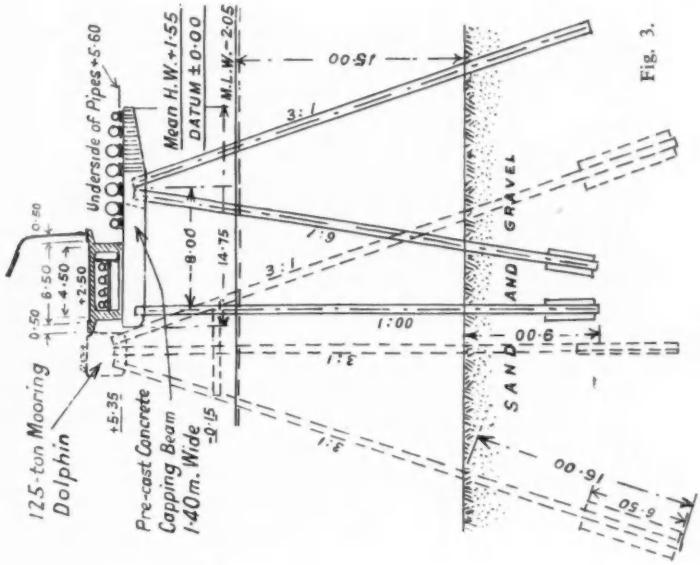
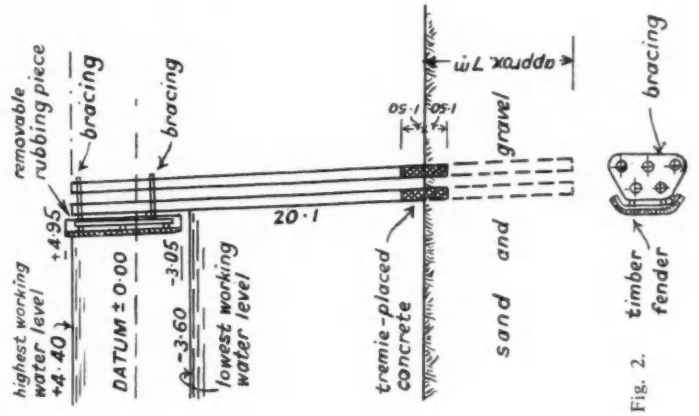


Fig. 3.



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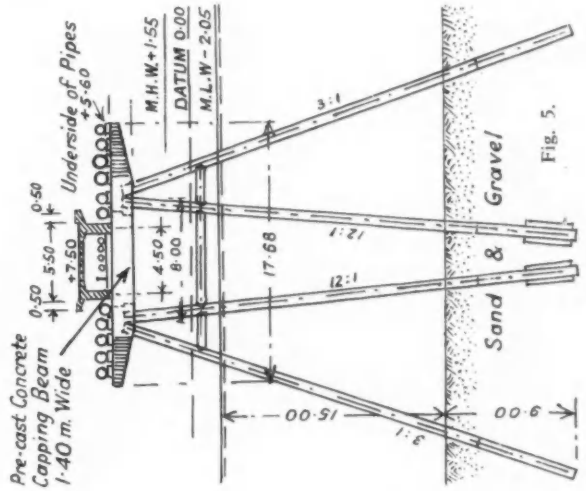

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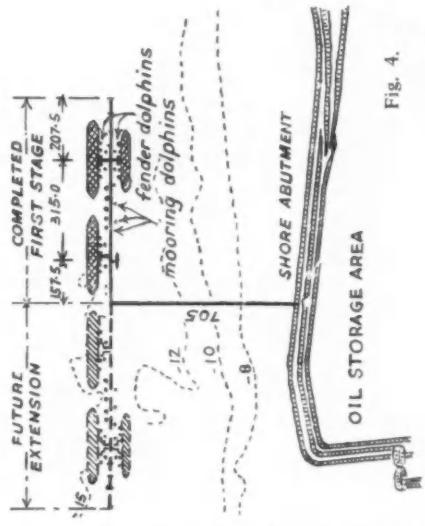


Fig. 4.

Fig. 1. 250-ton mooring dolphin.
Fig. 2. Flexible fender dolphin.
Fig. 3. Cross-section through jetty head.
Fig. 4. Key plan of jetty.
Fig. 5. Cross-section through approach.

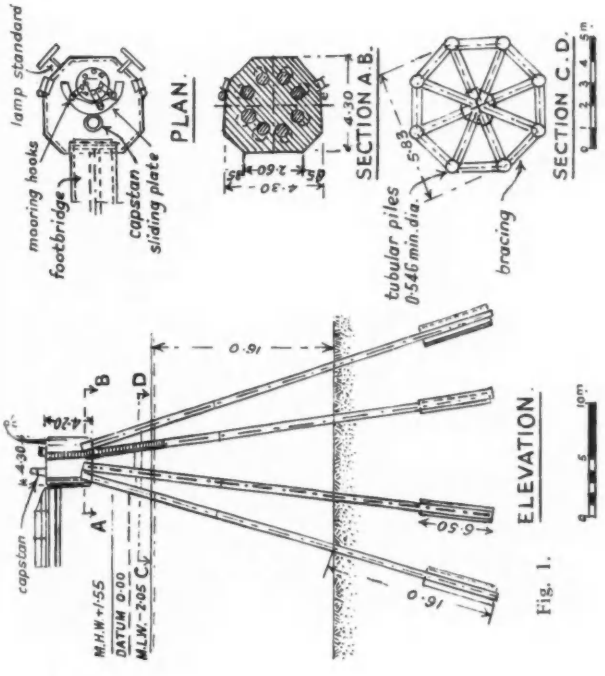


Fig. 1.

The effect of the new jetty on the hydraulic and hydrographic conditions, and vice versa, were investigated by means of model tests, which showed that the directions of the incoming and the outgoing tidal currents did not coincide but formed an angle of 6° with each other. The axis of the jetty head was accordingly given an "average" direction corresponding to the bisectrix of this angle.

The design of the oil jetty was complicated by the large tidal range, entailing considerable variations in the depth of the water alongside, and by the varying sizes and draughts of the tankers to be accommodated (vessels ranging from 12,500 to 100,000 tons deadweight were envisaged in the specification). The mean high and low water levels are +1.55 m. and −2.05 m. with respect to German Standard Datum. The extreme "working" levels on which the design of the jetty was based were +4.40 m. and −3.60 m. respectively, these values being exceeded with a frequency of only about once in every ten years.

The fendering system adopted after careful investigation of the problem consisted in providing at each berth a set of four flexible, torsionally rigid dolphins constructed of tubular steel piles of 750 mm. diameter. These dolphins are provided with timber fenders, the faces of which are 5 m. in front of the face of the berthing pier that they protect. Under normal conditions of operation vessels do not touch the berthing piers. The latter have nevertheless been provided with sufficient raking piles to withstand considerable horizontal forces, so as to escape exten-

sive damage in the event of collision with a vessel. The jetty is furthermore provided with structurally independent mooring dolphins designed for pulls of 125 tons and 250 tons and constructed of clusters of tubular steel raking piles surmounted by concrete blocks.

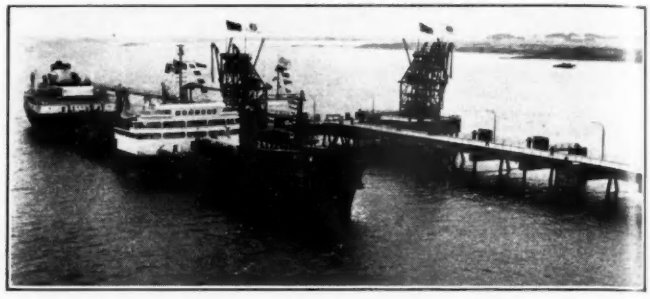
The first stage of the scheme, as completed in 1958, provides berthing facilities for three tankers, viz., two on the seaward and one on the landward side of the jetty head. The scheme for the future extension of the jetty provides for the construction of a second arm to the jetty head, thereby increasing its capacity to six berths. The principal structural features of the oil jetty are the shore abutment, the approach (with spans of 15 m. between successive pile bents), the jetty head (a multi-span bridge-like structure generally similar to the approach), the berthing piers, the fender dolphins, and the mooring dolphins, together with their access footbridges. The berthing piers are, in effect, small secondary T-headed jetties, consisting of platforms 18 m. x 22 m. in size, their front edges being about 33 m. from the axis of the main jetty head.

The jetty approach and the jetty head carry a 5.50 m. wide roadway, this being in the form of an elevated reinforced concrete structure comprising a carriageway of 3.00 m. and a parking strip of 2.50 m. The centre-line of the roadway is located at the level +7.50 m. An inspection footway is accommodated in the space under the roadway. On the jetty head the oil mains are carried on the landward side of the roadway, whereas on the approach structure they run on both sides of the roadway.

The entire jetty is founded on seamless tubular steel piles of 546 mm. diameter, provided with enlarged toes formed by welded-on " wings " consisting of halved " Peiner " sheet pile sections. The design loads for the general foundation piles supporting the jetty aproach and jetty head were in the range of 100—180 tons per pile. These piles have lengths varying from 28 to 35 m. The piles of the mooring dolphins have to resist pulls of up to 230 tons and compression loads of up to 280 tons. They have lengths of up to 43.50 m. and are provided with 6.50 m. long " wings " consisting of " Peiner " Psp 60 L sections.

For anchoring the piles securely into the concrete superstructure of the jetty, short lengths of railway rail were passed transversely through holes cut in the pile heads and were welded to them. In addition, the heads were provided with a number of welded-on hooked steel straps for embedment in the concrete. The piles of the mooring dolphins have a wall thickness of 16 mm. at the top, which is reduced to 14 mm. in the portion of the pile below sea bed level; in the case of the general foundation piles of the jetty the corresponding thicknesses are 15.5 mm. and 13.5 mm. respectively. All the piles were sandblasted down to a depth of 2 m. below sea bed level and were given four coats of coal-tar pitch. In addition, arrangements have been made for the installation of an impressed-current system of cathodic protection at a future date.

All horizontal forces acting on the various parts of the structure are taken up by raking piles. Expansion joints spaced 120 m. apart have been provided in the jetty head and in the approach structure. The longitudinal forces acting on each 120 m. long section are taken up by two central pile bents containing four pairs of 3 : 1 raking piles. The transverse capping beams of the pile bents are precast units weighing 75 tons each (in the case of the approach structure) or 65 tons (in the case of the jetty head). They were erected with the aid of a floating crane and were fixed to the piles by means of in-situ concrete. In-situ construction was used only for the capping beams of the above-mentioned central pile bents designed for resisting longitudinal horizontal thrusts and for the beams incorporated in the berthing piers and in the platform at the junction of the jetty head and the approach. The other parts of the superstructure, as well as the



A tanker berthed at the new jetty head.

footbridges giving access to the mooring dolphins, are likewise of precast construction and were erected with the aid of a floating crane. The standard precast units for the jetty superstructure weighed 137 tons each. The joints between the units were, in general, formed by pouring in-situ concrete around the reinforcing bars which had been left projecting from each unit so as to overlap with those of the adjacent units. In this way continuity was established over lengths of 120 m. between successive expansion joints.

Execution of the Work

The design for the oil jetty prepared by the consulting engineers (Ingenieursbüro Prof. Dr. Agatz Nachf., Bremen) envisaged the use of normal reinforced concrete throughout the superstructure, though the contractors invited to tender for the job were permitted to submit variant schemes in which prestressed concrete could be used if considered necessary. The scheme eventually adopted for execution was, however, that prepared by the consulting engineers.

Tenders were invited from contractors possessing the appropriate qualifications and experience in the sphere of maritime civil engineering construction. The contract for the work was awarded to a combine consisting initially of the firms of Strabag-Bau AG, Hochtief AG, De Long Corporation, Hermann Möller, and Tiefbau AG Unterweser. The combine was subsequently joined by the firms of Ed. Züblin AG and Polensky & Zöllner AG. The conditions of the contract required that the work should be started on the 1st November 1957 and be completed not later than the 1st September 1958.

The successful combine proposed that an artificial " island " of novel conception, developed by the De Long Corporation, be

Rear view of jetty head showing oil pipelines.

used as a movable piling platform. This structure was equipped with a piling frame which could be moved longitudinally and transversely on a special sled type device and which could moreover be turned in any direction and tilted for driving piles at a rake of up to 3 : 1.

The superstructure of the piling island consisted of a 37 m. long by 21 m. wide platform, which was supported on eight tubular steel legs of 1.80 m. diameter. These legs could be raised or lowered independently of one another (by means of pneumatic jacking equipment) so that they could adapt themselves to the irregularities of the sea bed. The island was provided with living quarters for the personnel, air compressors, generators, tanks containing boiler feed water for producing steam for the pile hammer, drinking water tanks, workshops for minor repairs, etc. A special sliding carriage, or sled, on which was mounted a Menck MR 60 piling frame, was developed in collaboration with the firm of Menck & Hambrock GmbH, Hamburg. The piling frame was equipped with a semi-automatic pile hammer with a falling weight of 6,750 kg. delivering 50 blows per minute. The

General view of jetty head.

hammer was operated with steam supplied by an oil-fired water-tube boiler. The sliding frame could be mechanically tilted either backwards or forwards. The hydraulically operated sliding carriage on which it was mounted could be moved a distance of 6 m. in the longitudinal and in the transverse direction. It was thus possible to drive all the piles of a bent, and also all eight piles of a 250-ton mooring dolphin, in succession without having to move the piling island to a fresh position.

It had originally been intended to equip the mooring dolphins with bollards, but in order to facilitate the manipulation and, in particular, the releasing of steel hawsers, specially developed swivelling hooks were installed in their stead. Depending on the magnitude of the pull to be taken up, each dolphin was provided with one, two or three such hooks. In addition, the dolphins were equipped with 1-ton electric capstans.

The construction of the Wilhelmshaven oil jetty involved the driving of 416 steel piles of 546 mm. diameter for supporting the superstructure of the jetty head and approach spans (piles up to 35 m. in length and up to 7.5 tons weight), 116 steel piles of 546 mm. diameter for the mooring dolphins (up to 43.5 m. in length and 10 tons weight), and 52 steel fender dolphin piles of 750 mm. diameter (up to 34 m. in length and 14.3 tons weight, maximum wall thickness 33.5 mm.).

In all, some 5,300 tons of structural steel and upwards of 1,500 tons of steel reinforcement were used in the construction of the jetty and dolphins. Over 5,500 m³ of precast concrete were used for the capping beams of the jetty head and approach and for their superstructure. The total quantity of in-situ concrete employed was 3,800 m³.

The completion of this major structure in such a short time was made possible by the following factors: (1) a large-scale use was made of precasting technique; (2) the job was executed by a combine of contractors with considerable technical resources at their disposal; (3) the piling island proved to be a highly efficient piece of equipment; (4) the promoters of the scheme co-operated in every way to speed up its execution; (5) plant and materials were supplied within the stipulated times; (6) considerable enthusiasm and energy were displayed at all levels by the men employed on the job.

The jetty is, of course, provided with all the usual ancillary equipment and services such as lighting installations, oil fuel pipes, supply mains for drinking water and ballast water, fire-fighting appliances, etc.

Each berthing pier is equipped with a flexible hose handling frame, of steel construction carrying five 12-in. flexibles for connecting the discharge pipes of the tankers with the oil mains of the jetty. By means of this arrangement connections to tanker discharge pipes can be effected over a total vertical range of 14 m. (the extreme discharge pipe levels are those of a fully laden small tanker at low tide and those of an empty large tanker at high tide respectively) The oil is pumped into the jetty mains by the tankers' own pumps at rates of up to 6,000 m³ per hour. Each hose handling frame is also equipped with two 10-in. oil fuel hoses and with two derrick cranes for such general cargo handling as may from time to time be necessary.

From the piers the oil is conveyed through 30-in. mains to a distributing plant for distribution to the various tanks in the oil storage area on shore.

Oil Storage Area

The storage facilities associated with the new oil jetty at Wilhelmshaven cover an area of 1.5 million square metres and initially provide tank capacity of 440,000 m³, with scope for subsequent extension to over four times this figure. At present the installation comprises 14 tanks of 31,500 m³ capacity each (55 m. in diameter and 13 m. high), a pumping station which pumps the oil into the long-distance pipeline to the Ruhr District, an oil separating plant for the removal of oil pollution from waste water, a control centre, a plant for building up high water pressures for fire-fighting purposes, a fuel oil installation, and administrative buildings. The present storage capacity at Wilhelmshaven represents about four weeks' supply for all the refineries connected to the supply system.

The pumping station, equipped with three pumps, forces oil into the 70 cm. diameter pipeline under a pressure of 70 atm, at a rate of 1,500 m³ per hour. This can, at a later stage, be increased to 2,000 m³ per hour by fitting the existing pumps with impellers of a different type. To achieve the envisaged eventual pipeline capacity of 3,000 m³ per hour it will be necessarry to build three further pumping stations.

All valves and other apparatus associated with the pipeline and pumping plant, and the pumps themselves, are electrically operated by remote control from a central point. Supervisory apparatus for measuring the temperature and density of the oil is installed all along the pipeline and provides a constant check on the flow conditions and on whether each refinery is, at any given time, receiving the correct type of crude oil intended for it. All the remote control and supervisory equipment is installed in the control centre at Wilhelmshaven, where the indicator readings of the various measuring instruments are directly available and the necessary manipulations for regulating the pumps and actuating the valves are effected.

Correspondence

To the Editor of the Dock and Harbour Authority

Sir,—

The Administration of Terminal Facilities for Overseas Trade

The editorial notes of your issues for September and October last, dealing with the article entitled as above, refer to the recent judgement on Midland Silicones Ltd., v. Scruttons Ltd., reported in your publication May 1959. It is stated that a drum of chemicals was dropped negligently by defendent's servants (Scruttons Ltd.) while the drum was being loaded on to a lorry for delivery. It is not clear at what particular point of delivery the incident occurred, which would be of paramount importance as at some stage during this process custody of the drum would change hands.

This of course is parallel in some respect to the question of the termination of the contract of affreightment. While I fully agree with the principal of Mr. Chrimes paper, I am not clear with the thought, "that the Port Authority should endeavour to delegate to licensees all those functions falling, so to speak, within the scope of the Shipowner's contract of carriage"

Firstly the question arises if it is within the province of the port authority to delegate these functions, secondly I feel sure that Mr. Chrimes is aware of the difficulty of establishing some conventional basis particularly in view of the adamant attitude of shipowners that the contract commences and terminates at the ship's rail.

Under the common law, the obligation of the shipowner, in the absence of expressed provision to the contrary, is to take the goods at the ship's rail and deliver them at the ship's rail to the consignee. That is, he must put them so far over the ship's rail as that the consignee can begin to act upon them.

Rule 2 Article III of the Carriage of Goods By Sea Act 1924, reads as follows.

"Subject to the provisions of Article IV, the carrier shall properly and carefully load, handle, stow, carry, keep, care for and discharge the goods carried."

Article IV deals with rights and immunities.

The phraseology of Rule 2, Article III, seems to make it clear that it is intended to prescribe, not merely the limits of the exemption clauses presumably to the carrier, but also the extent of the services he shall be deemed to have undertaken to perform. It may probably be considered therefore that the categorical wording of Rule 2, Article III, impose upon the carrier the obligation to perform the whole of the operations of loading and discharging, properly and carefully.

The interpretation of the words "loading" and "discharging" may give rise to some difficult questions of fact.

It has been held that the discharge of goods by ships direct to lighter was not complete until all the cargo which it was contemplated should form the lighter load had actually been put into the lighter, and that, therefore, the Act and Rules applied until that had been done. This unusually wide meaning given to the word "discharge" seems open to doubt.

The Belgium Courts in constructing both the English Act and the Belgium Hague Rule legislation have held that goods are not discharged within the meaning of Rule 2, Article III, consequently the liability of the carrier is not terminated, until they have been effectively put at the disposal of the consignee. Thus a carrier has been held liable for damage done to cargo while lying in a shed on the quay at the port of discharge, as it had not then been sorted and so not put at the disposal of the consignee.

Lloyds List Law Reports December 31st 1951, gives the Judgment, Waters Trading Company Ltd. v. Dalgety and Co. Ltd. which states that the effect of the Hague Rules is (inter alia) to impose upon a shipowner an obligation properly and carefully to load and discharge the goods carried, and precludes the making of any agreement which places the sole risk upon the shipper or consignee during the period between loading and discharge. Outside this area of performance the parties were uncontrolled in this respect and could agree upon any terms which they might think proper. But the contract was one complete agreement to accept, carry, and deliver the goods in question to the consignee or to his order, and was not completed by a mere landing of the goods on the wharf when the tackle was unhooked in the process of discharge. This act marked the point of time when the shipowners' obligations under the Hague Rules came to an end, but the contract was not thereby exhausted. It was clearly contemplated that a further period of time would elapse pending actual presentation of the bill of lading or a delivery order.

A question of practical importance arises in cases to which the Rules apply as to whether it is permissible to carry goods under bills of lading containing such clauses called "free in and out" (F.I.O.) and "free delivery" (F.D.).

"Cargo to be loaded, stowed and trimmed free of risk and expense to the owners".

"The cargo to be loaded and discharged at charterer's risk and expense."

"Consignees to discharge the cargo free of risk and expense to the ship."

Section 31 of your correspondent's paper suggests that a 50: 50: split assessment between cargo and vessel is suitable for wharfage dues, that is between cargo and N.R.T. of vessel budgeted during a national average year, estimating further so that wharfage per N.R.T. of vessel can be broken down into "wharfage per N.R.T./day."

The Singapore Harbour Board imposes a minimum wharfage assessed on a rate multiplied by N.R.T. if that sum exceeds a rate multiplied by the actual manifest tons of cargo worked.

Ships, for various reasons, particularly when using transit ports, are sometimes apt to apply for loading berths before cargo is available and it is therefore politic to impose a minimum wharfage assessed to act as a deterrent to such malpractice. Demurrage of wharves (berths) is equally important to the port authority as is demurrage of ships to the owner. This minimum charge should be variable and readily amended compatible to the volume of trade the port currently deals with. Indeed the same principal should apply to store rent as an incentive for consignees to remove their goods from transit sheds within a reasonable period.

Finally, when assessing wharfage dues collected from lightered cargo, some stipulation as to the length or size of a lighter should be inserted in the tariff as views do not always coincide whether vessels are lighters, or "small ships". This in the main is necessary for the lineal footage of wharf occupied and the carriage of goods beyond harbour limits.

1-5 Broad St. Place,
London E.C.2.
30th November, 1959.

Yours faithfully,
W. H. LAIT,
Port Consultant.

Development of Lautoka Port, Fiji

Under the Colonial Development and Welfare Acts, a grant of £337,500 has been made towards the cost of providing a new deepwater wharf at Lautoka, second port of the Fiji Islands. This grant represents one quarter of the estimated cost of the scheme, which is intended to improve export facilities to assist local industries. At present, goods for this area are unloaded at Suva and are transported either by coastal shipping or by lorry over 150 miles of mountainous roads. The new port facilities will include a reinforced concrete wharf served by a 1,100-ft. mole and equipped with a steel-framed concrete shed. The sea approaches will be dredged to provide access for ocean-going vessels and the spoil will be used for reclaiming an area for open storage.

Recently 145 grants, totalling £3¼ million were approved to aid the economic progress of Great Britain's overseas territories. Of this sum £881,728 will be used to develop port facilities.

Australian Stevedoring Industry

Abstracts from Annual Report

The Australian Stevedoring Industry Authority recently issued their Annual Report and Financial Statement for the year ended 30th June 1959, and the following extracts are of general interest.

Trade and Employment

During the year, a number of developments, including increased use of mechanical equipment, "unitisation" of certain cargoes and the introduction of new berths at some major ports, resulted in higher rates of work and speedier turn-round of vessels. Compared with 1957/58, man hours declined by 3% and tonnages handled by waterside workers increased by nearly 3%. The decline in the active labour force was relatively greater than the fall in the number of man hours worked and there was thus a slight improvement in average weekly hours. Nevertheless, excessive surpluses of men continued at most of the principal ports. As a result of the slightly higher average weekly hours and the effects of basic wage increases, earnings rose.

For the first time on record, the number of man hours worked during the year at Melbourne (Cargo Section) was greater than the total for Sydney. Ports other than Melbourne to record an increase included Port Kembla, Brisbane, some other Queensland meat loading ports and the main northern Tasmanian ports. For Australian ports as a whole, time lost through industrial stoppages was the lowest ever recorded. For both overseas and interstate trades, there was an increase during 1958/59 at most major ports in the percentage of total working time classified as non-productive.

With the recovery from the drought conditions of 1957/58, there was a big increase in exports of primary products. The tonnage of wool increased by more than 8%, while meat and freezer tonnages rose by 42%. There was also a substantial increase in exports of wheat and other grains. The tonnage of all overseas cargoes discharged was less than in the previous year, while the total volume of interstate trade also declined.

In 1958/59, a total of 24.3 million tons was handled by waterside workers compared with 23.6 million tons in the previous year. Increased tonnages loaded at capital city ports for overseas destinations accounted for the greater part of the rise.

Man hours worked declined from 31.0 million in 1957/58 to to 30.2 million in 1958/59. Although a general decline in man hours has been characteristic of the period since 1954/55, the rate of decline tapered off during the past year. Over 36% of the man hours worked was spent on the loading and discharging of cargo classified as general cargo. More than 90% of all general cargo is handled at the six capital city ports.

While there was a slight increase during the year in the quantity of overseas general cargo loaded, this was more than offset by a fall in the tonnage of overseas general cargo discharged as well as in the quantity of interstate general cargo handled.

Compared with the previous year's total, in each instance, the tonnage of interstate general cargo loaded and discharged at the six capital city ports fell by less than 1% during 1958/59 compared with a fall of 9% in 1957/58. At Brisbane, Sydney and Fremantle, tonnages declined, but at Melbourne and Port Adelaide there were increased tonnages.

At most ports, there was little change from the previous year's cargo handling rates for overseas general cargo. For interstate general cargo, however, a marked improvement in rates of work was recorded at each capital city port. At Port Adelaide, handling rates for this cargo were considerably higher than in the previous year. The improvement is the more significant in view of the decline in recent years in the number of men in gangs handling this type of cargo. During 1958/59, there was a greater use of pallets and containers in this trade.

Some of the most outstanding improvements in handling rates were evident in the loading and discharging of interstate iron and steel cargoes. In August, 1958, pre-slung iron and steel was shipped from Port Kembla to Kwinana for the first time. Moreover, with the introduction of new discharging facilities at Melbourne and Port Adelaide, it was possible to ship increased quantities of pre-slung iron and steel cargoes from Newcastle to those ports. At both Newcastle and Port Kembla, the proportion of interstate iron and steel tonnages handled by shore cranes increased. The average size of gangs handling steel cargoes was reduced, especially at Brisbane, Newcastle, Melbourne and Port Adelaide.

As a result of increased rates of work and reduced gang sizes, there has been less work for waterside workers on these cargoes.

At the six ports mentioned, man hours worked on interstate iron and steel cargoes were 18% less than in the previous year despite a 17% rise in tonnages handled. At Melbourne, tonnages of interstate iron and steel cargoes discharged rose by over 10% but man hours fell by nearly 40%.

General cargo together with iron and steel accounted for 43% of all man hours worked during the year. Meat, freezer, wool, sugar, flour, grains and timber accounted for a further 25%. Improved seasonal conditions and, in the case of meat, favourable developments in overseas marketing, resulted in a substantial increase in exports of primary products; the tonnage of barley loaded rose by 37%, and that of wheat by 10%. Exports of wheat from the eastern States were resumed during the year. The quantity of flour loaded was about the same as in 1957/58. Mainly as a result of the introduction of bulk sugar loading at Lucinda Point, the tonnage of sugar loaded by waterside workers fell by 27%; the tonnage of overseas timber (including logs) discharged was slightly less than in the previous year.

Compared with the previous year, there was some improvement in the turn-round of vessels at the six capital city ports during 1958/59.

Turn-round of Vessels

(Six Capital City Ports combined)

	Overseas Vessels		Interstate Vessels	
	1957/58	1958/59	1957/58	1958/59
Average Quantity of Cargo Handled per Visit (Tons)	1814	1642	1940	2031
Average Number of Days in Port per Visit	4.7	4.2	4.1	3.8
Average Number of Working Days per Visit	3.9	3.5	3.3	3.1
Average Quantity of Cargo Handled per Working Day (Tons)	468	473	590	664

For overseas vessels, a slight increase in the quantity of cargo handled per day was recorded. On average, these vessels spent less time in port. A smaller quantity of cargo, however, was handled each visit.

A marked improvement was recorded for the turn-round of interstate vessels. A slightly greater quantity of cargo was handled each visit in a shorter time. On average, for each working day in port, 664 tons of cargo were handled during 1958/59, compared with 590 tons in 1957/58.

Labour

Average daily registrations at all ports fell by 5% from 24,720 in 1957/58 to 23,494 in 1958/59, as against the 3% fall in man hours discussed earlier. The decline in registrations was particularly evident at Brisbane, Sydney, Melbourne (both sections), Port Adelaide, Hobart and Newcastle (coal section). At Port Kembla, average daily registrations rose by 15%. For all ports

the average daily number of waterside workers fell by 3% from 14,960 to 14,525. A significant fall in the average daily number of men absent or suspended through dispute resulted in a decline in unemployable labour.

Since 1956/57 excessive numbers of waterside workers have been available for employment, with resultant heavy attendance money payments. On average 22.1% of all men were on attendance money each day last year compared with 21.1% in 1957/58. An examination of labour turnover for the year disclosed that both the intake and exodus rates were lower than in 1957/58, and there has been a continued decline in the rate of intake over recent years. The average age of main register men was 44.8 years, compared with 44.0 in 1957/58. The percentage of disability men was 17.4, compared with 16.4 in the previous year.

Hours and Earnings

For all Australian ports combined, average weekly hours worked and earnings of waterside workers were higher than in the previous year. The following table provides a comparison for the last three years of average weekly hours for each capital city port and for all Australian ports:

Average Weekly Hours per Waterside Worker of the Real Labour Force

	1956/57	1957/58	1958/59
Brisbane	23.2	19.9	22.5
Sydney	25.9	25.4	26.7
Melbourne (Cargo) ...	29.1	29.3	31.0
Port Adelaide ...	29.8	26.3	26.7
Fremantle	28.5	26.7	25.4
Hobart	26.4	26.7	26.2
Australian Ports ...	26.9	25.0	25.8

It will be observed that increases were recorded at all capital city ports excepting Fremantle and Hobart. The average weekly hours for Melbourne (cargo section) over the last two years have been considerably higher than those for other capital cities.

For all Australian ports combined, average weekly earnings in 1958/59 were £19 5s. 6d. compared with £18 11s. 9d. in 1957/58. Gross earnings rose at all capital city ports other than Fremantle.

Mechanisation and Improved Methods

Faced with continuing competition from land transport in Australia, the stevedoring industry has maintained the move towards greater use of mechanisation and improved handling methods which was reported last year.

Interstate shipping was faced with competition from land transport which in many cases could deliver goods more cheaply and speedily, and with less damage. The development of durable containers by the industry has tended to meet competition on this latter aspect. Greater use was made of fork-lift machines in ships' holds.

Improved methods of handling meat helped in augmenting current export earnings, and in making a success of the "northabout" operation in which ships are carrying Australian chilled beef to England in 28 to 30 days. Marked improvement in handling steel products and scrap iron was an outstanding feature of waterfront efficiency. Development of bulk handling continued to have serious repercussions on waterfront employment, and in some cases led to inter-union demarcation disputation.

Other examples of improved facilities and methods were:

Bulk Handling

Bulk handling installations for soda ash at Port Adelaide and Sydney were used during the year.

Bulk sugar installations came into operation at Lucinda Point and Bundaberg. The first of the season's sugar was received at the new bulk sugar installation at Townsville in June 1959 for early shipment. Bulk sugar facilities are planned to operate at Mourilyan in 1960. The first bulk shipment of sugar was discharged at Port Adelaide during the year.

The construction of the bulk wheat terminal at Pinkenba was completed during the year and actual loading operations were expected to start shortly afterwards. Experimental shipments of wheat were made from the Port Lincoln bulk grain terminal which is expected eventually to load 9,000 to 10,000 tons of wheat in less than three days. Bulk grain loading facilities came into use at Wallaroo and installations to receive bulk wheat were introduced at Launceston and Hobart. At Geelong, the operation of the bulk-handling coal berth at Corio Quay and the bulk handling of oats from the grain elevator berth were recent developments. The automatic coal loader which came into operation at Newcastle is regarded as experimental. It has a fixed loading spout, which requires the shifting of the ship in order to load the different hatches of the vessel. However, it resulted in a considerable saving in labour costs.

During the year, the British Phosphate Commission experimented with the discharge of bulk phosphate rock at Appleton Dock, Melbourne, using shore cranes and large grabs.

Discharging Steel Products

One of the most important developments in efficiency during the year was the operation of the new steel handling berth at 21 South Wharf, Melbourne. At this berth luffing cranes capable of discharging by means of electro-magnets, have been erected. The shed has been fitted with traversing cranes for clearing under the hook, stacking cargo, and loading directly onto road transport. The intensification of steel discharge at this wharf freed for other uses four berths which in past years had been used virtually full time in the handling of this cargo.

The first vessel to discharge steel at this new berth was the "Iron Duke," which commenced at 8.00 a.m. on Monday, 25th August. This vessel had a cargo of approximately 7,200 tons of steel, wire, pipes and plates in five hatches. Some 1,200 tons of steel and 2,000 tons of pipes were pre-slung, while the plates were "glutted" ready for discharge. The wire was stowed in the normal way. When pre-slung cargo was being handled by shore cranes, a basic gang of seven men was used. This comprised one hatchman, two holders and four wharf men. Whenever a sling had to be made up in the hold, four holders were used. The number of wharf men at each hatch varied from four to ten, according to the type of cargo being discharged and the number of marks. The overhead shed cranes assisted in top-stacking, loading trucks, and running from hook to stack. At various times, additional mobile cranes and fork-lift machines were also used. The average sling loads were five tons for pre-slung steel and three tons for pre-slung pipes and pre-glutted plates. The "Iron Duke" has sliding beams and for this discharge all beams were positioned at the end of the hatch. However, this slowed the rate of work when long lifts were being handled, and it was arranged that in future all beams would be removed and stowed on the wharf. The very large sling loads and the comparatively fast rate of discharge were a real test for the capacity of the shed and necessitated special transport arrangements. Discharging was completed at 10.30 p.m. on Friday, 29th August. Approximately 7,200 tons were discharged in a gross time of about 370 hours and a net time of about 245 hours. An average of about 29 tons per gang hour net was maintained. By comparison, the same vessel discharged 6,183 tons between 8.00 a.m., 4th August, and 11.00 p.m., 13th August. On that occasion there were 491 gross gang hours, 362 net gang hours, with a net rate of 17.08 tons per gang per hour.

At Port Adelaide, four shore cranes of 6 tons safe working

head, which have been erected at Nos. 13 and 14 berths primarily for handling steel, made a big improvement in the rate of discharge and subsequent turn-round of ships.

At Newcastle the use of shipping containers for the carriage of small steel products—wrapped wire coils about 9-in. in diameter—which is at present in an experimental stage, seems likely to become an established practice.

Discharge of Pig Iron by Electro-Magnets

The first vessel to discharge pig iron by electro-magnets at 21 South Wharf, Melbourne, was the "Iron Knight" on 18th August, 1958.

For the discharge of approximately 5,000 tons of pig iron, each of four shore cranes was fitted with an electro-magnet, which could discharge an average of 30 cwt. per lift. The magnets discharged direct to road transport or on to heaps on the wharfs for subsequent loading onto lorries. Overhead shed cranes were also available to load road transports while discharge continued. Eleven men in all were employed on the four holds for the day shift and five men on the evening shift. From 8.00 a.m. Monday to 5.00 p.m. Thursday, approximately 5,100 tons were discharged at an average rate of slightly less than 40 tons per gang per hour. Prior to this vessel, pig iron was discharged with gangs of 15 men, the average rate varying from 15 to 20 tons per gang per hour.

Use of Pallets and Containers

There was increasing use of containers, pallets and pre-slinging in the interstate trade. Some cargoes were being bound to the pallet by metal straps. This increased the handling rate, reduced breakages and damage, and enabled the use of reduced gangs when sufficient cargo of this nature was being handled. Aluminium and zinc from Tasmania were shipped in strapped bundles weighing about a ton each. This system resulted in a much better rate of discharge.

The use of containers resulted in more expeditious handling of cargo, the elimination of sorting and stacking charges and of pillage. While the stowing of pre-slung cargo did result in lost space, it greatly improved the handling rate in both loading and discharging operations. These methods of handling cargo were more common in the Tasmanian trade.

Extended Use of Fork-lift Machines

The use of electric fork-lift machines in the holds, which overcame objections to the possible generation of fumes, and the use of fans to dispel fumes when ordinary fork-lifts were used, contributed to greater efficiency. Fork-lift machines were used more extensively on the wharves to carry general produce and other bagged cargo, in addtion to the heavy types of cargo previously carried.

Meat Loading

A special type of gear for loading chilled beef into vessels was introduced during the year. It consisted of a mobile shore hanging platform, a platform for use in the ship's hold, and a gantry, which was erected on the hatch coaming of the vessel.

In the meat ports, wooden trays replaced nets for the loading of cartons containing boneless beef and sundries. These trays did not increase the loading rate appreciably but delivered the cargo to hatches in better condition.

The method of packing meat cuts in cartons, instead of shipping carcases, increased during the year. This resulted in a saving of freezer space and a better stow generally.

. . . . .

It is not desired to minimise the fact that mechanisation is a serious human problem for the displaced waterside worker. However, in the interstate trade, failure to mechanise stevedoring would not result in more employment for waterside workers. Almost certainly such failure would result in an increased diversion of sea cargoes to land transport, with loss of work to waterside and maritime workers generally. Any gain in employment from the failure to mechanise stevedoring would go to the land transport industries.

In international trade, failure to adopt the world standard of mechanisation, e.g. bulk handling for certain products, could only result in these products being unable to compete on world markets, with disastrous consequences to the Australian economy.

Time Lost Through Industrial Stoppages

During the year, 345,889 man hours were lost as a result of industrial stoppages. This total is 1.1% of the man hours worked and is the lowest since records were first kept under the Commonwealth's registration systems in 1947. There was a loss of 4.8% in the previous year. The second lowest loss occurred in 1948/49 when 647,700 man hours, being 1.8% of the time worked, were lost.

Finance

The financial position of the Authority improved during the year. The Stevedoring Industry Charge Act 1958 increased the levy rate to 3/- from 1st April, 1958, until 30th June, 1959. The increase was based on a current need of 2/6d., with a loading of 6d. aimed at liquidating overdraft liabilities and providing working reserves of cash.

This assistance to the Authority's finances was reinforced by a rise of 800,000 man hours worked over estimates prepared at the commencement of the year. The policy of limiting recruitment to the industry was continued, and registered strength fell by 1,147 or 4.7% during the year compared with a lower rate of fall of 2.6% in man hours. This relative increase in work opportunity reversed the trend of the past two years.

The increased levy and improved relative work position combined to enlarge the Authority's income by £1,237,287. As a result, the overdraft at the commencement of the year was converted to a cash in bank position of £656,766 by 30th June, 1959.

Income

Total income for the year was £4,575,752, an increase of £1,237,287 over 1957/58.

Expenditure

Main items of expenditure were:

Attendance Money	£1,697,120
Sick Leave paid or accrued	349,579
Holiday Pay	602,212
Other payments to or for Waterside Workers ...	151,299
Total payments to or for Waterside Workers ...	£2,800,210
Administration, including labour bureau operation, sundries and adjustments	549,602
Total Expenditure	£3,349,812
Excess Income over Expenditure	£1,225,940

Total expenditure decreased by £74,616 compared with last year. Payments to or for waterside workers accounted for a decrease of £63,322, whilst adminstrative costs decreased by £11,294. (The statutory payments to waterside workers of attendance money, sick pay, and holiday pay decreased due to the continued decline in the work force.)

Design of Quayside Shed for Port of Tamatave

Requirements and Equipment for General Cargo Handling*

By A. AUBERT (Chief Engineer, Ponts et Chaussees, Technical Consultant of Equipment, Madagascar)

THE deep water quays of the port of Tamatave, Madagascar, were constructed between the years 1930—1936. They were designed to handle 150,000-tons annually, but trade grew steadily and in 1956 the goods traffic had reached 400,000-tons without any extension of the port or its installations. In 1953 the Author was invited to advise the administration on the port's development and to supervise the construction of a fully equipped quay.

In the existing port the main quay No. F4 was on Mole B (Fig. 1). This mole is 170-metres long and 45-metres wide in 9-metres of water and is equipped with one 2-storey shed of reinforced concrete 120-m. long and 20-m. wide with a total floor space of 4,700-sq. m. The front side walls have seven openings 3.20-m. wide and 3.80-m. high, fitted with sliding doors on both floors; at ground level only the rear wall has openings similar to the front wall. Communication between the upper and lower floor is effected by two staircases, two 2-ton lifts with cargo areas of 4.50-m., and two sliding chutes.

The quay is equipped with six electric portal cranes of 3-tons capacity and maximum radius of 17.75-m. A strip 10-m. wide from the quay coping is accessible to both road and rail vehicles, the two lines for the latter being straddled by portal cranes. Landwards from the strip there is a raised platform 0.80-m. high and 6.45-m. wide from the side wall of the shed. The level of the shed floor is at the same level.

In spite of the inadequacy of the installation, it was possible to obtain in 1955 over the length of this quay an average of 508-tons per day for 321 working days, i.e., a return of 960-tons per annum per metre length of quay.

The Author's proposal was for a quay 300-m. in length with a depth alongside of 10-m. at which two vessels could berth simultaneously and which would be equipped to handle general cargo.

Accepting that the main factor of efficiency lay in the avoidance of any structural interference with the free movement of exports and imports, it was necessary that the buildings should facilitate carrying out both these operations simultaneously. It was initially decided, therefore, to construct a 2-storey transit shed which would handle imports on the upper floor and exports on the lower, as shown in Fig. 2.

Basing the dimensions of the shed upon a cargo figure of 1,500-tons of general goods at 4-sq. m. per ton, a floor area of 6,000-sq. m. or 120-m. by 50-m. was arrived at for the ground floor. From the coping of the quay to the edge of the rail platform in the shed there would a slight uniform gradient of 1 in 90 to enable mechanical appliances to circulate freely in the shed.

Selection of the Best Design.

As a general rule, where berths are being constructed in world ports today there is a tendency to increase the area of covered space.

At Marseille covered surface available alongside the quays varies between 4,000-sq. m. and 11,000-sq. m. At Le Havre each of the 150-m. berths of the new quay Hermann du Pasquier will have 7,000-sq. m. of covered surface. At Antwerp a joint shed of 21,800-sq. m. serves two berths, so giving about 11,000-sq m. covered area per berth. At Hamburg new construction conforms to standard dimensions which allow 9,000-sq. m. of covered surface per berth of 150-m. length of quay.

The above examples are all of single storey sheds. At Antwerp however, for the Belgian Congo traffic there are two 2-storey sheds each serving two berths; one of 26,000-sq. m. and the other 30,000-sq. m. the latter serving 250-m. of quay. From these examples, it can be concluded that the average covered space for a berth is approximately 10,000-sq. m.

The covered surface area of 10,000-sq. m. which was based on local experience and which was agreed as the optimum for Tamatave for each berth, was thus in line with European practice. The final assessment of the area of the covered surface depends also upon other factors which will be dealt with below.

It should however be mentioned at this point that recently in different parts of French Africa new construction has comprised covered surfaces as low as 4,000-sq. m. per quay berth, as at Dakar and Douala. At Dakar climatic conditions are favourable but at Douala, where the rainfall is comparable with Tamatave, only the future will show whether sufficient coverage has been allowed.

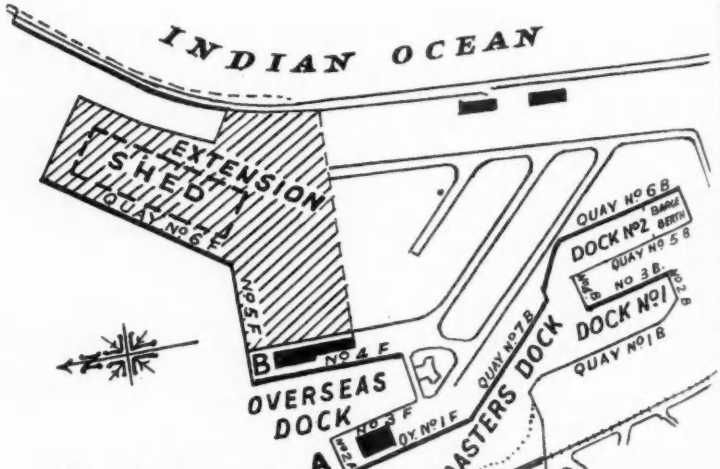


Fig. 1. General Plan of Port of Tamatave.

Single v. Double Storey Transit Sheds.

On the question of the relative merits of single and double storey sheds, it will be of advantage and interest to study the practice in the port of Marseille where, in past years, preference has invariably been shown for sheds of two floors. Since the 2nd World War, however, the Authorities have completely changed their point of view and now prefer the single storey shed.

In discussing the subject, M. Flinois, Director General of the Concessions of the Chamber of Commerce of Marseille, said that a 2-storey shed could only be justified where there was insufficient ground space. It mus be sturdily constructed to carry the burden of two floors loads, whereas the single floor shed is of relatively light construction and without serious foundation problems. As regards the costs of handling, every ton of merchandise passing over the upper floor costs 40 per cent more than that on the ground floor. This circumstance causes the stevedores to use

* Abridged translation of an article which appeared in "TRAVAUX"—December 1958 and January 1959.

the upper floor only when they are forced to do so. For this reason the mean annual utilisation per sq. m. of the upper floor is less than half that of the ground floor, i.e., 4-tons per sq. m. as against 10-tons for the ground floor. (Marseille)

Inspector General Peltier, at that time Director of Ports of the French Ministry of Works, gave the Author the following explanation for the change to single storey sheds in many ports.

Originally ports had no sheds but merely open standings the width of which was limited. These areas however were sufficient as the vessels were also small and imported goods were cleared away quickly to private warehouses; whilst for exported goods the vessels remained quite a while in the port collecting cargoes as, and when, they were delivered to the quayside.

Then came the necessity to construct sheds on the narrow standing alongside the quay and, little by little, the insufficiency of dimension of the sheds became apparent, due to the increase in the size of ships and modifications in their working routine. In particular, regular shipping lines which called for only a few hours at a port to pick up cargo, required space under cover for the collection of the cargo beforehand, and at the same time additional space was needed for the imports to be unloaded and stacked.

It was thereupon apparent that greater floor areas were required and, since there was no possibility of obtaining them at ground level, a second floor had to be utilised. On the other hand, since a greater width for berths has become a necessity,

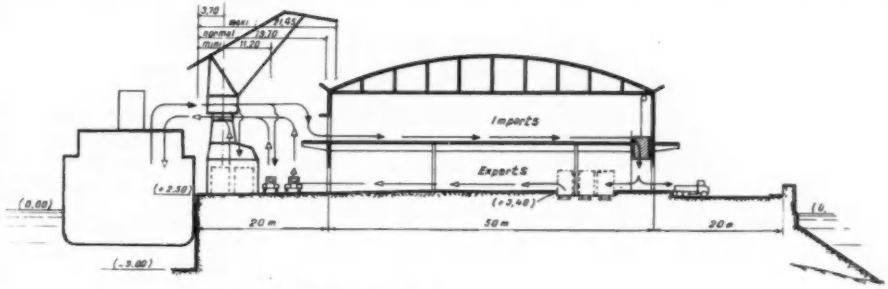


Fig. 2. Preliminary Project.

the single storey shed has attractions. In addition, only in recent years has the vertical handling of loads been mechanised as well as the horizontal movement.

The views of the engineers of Marseille are worthy of respect and their conclusions in favour of the single storey shed cannot be lightly dismissed. Nevertheless, in the opinion of M. Flinois, the 2-storey shed possesses the theoretical advantage of providing the means for the complete separation of the inward and outward traffic flow, which can be carried on simultaneously providing there is space for manoeuvre and storage, as in the shed No. 18 of 22,000-sq. m. at Marseille.

Moreover the engineers of Marseille are not alone in their conclusions and, in all the ports visited by the Author with one exception, engineers and port officials showed preference for the single storey shed. Mention should be made of the exception noted, which concerns the sheds in the Basin Leopold, Antwerp, which are operated by International Maritime Agency (A.M.I.) for the Belgian Maritime Company (C.M.B.).

The upper floor has an area of 8,630-sq. m. and the ground floor 17,200-sq. m. and the shed is used solely for the importation of agricultural produce from the colonies, each shipment normally consisting of 2,500-tons. The user of the shed receives before the arrival of each vessel of the C.M.B. the manifest and the ship's stowage plan. From these documents the place of each lot before transit through the shed is defined in advance and marked in white paint with a number on the areas of stowage. On the discharge of the vessel each pallet is immediately recognised and loaded on to fork lift trucks and carried to its assigned place. Further distribution is carried out by adjustable inclined chutes which deliver into wagon, lorry or the ground level platform. The C.M.B. and A.M.I. are well satisfied with this system.

The good working of this method results from the efficiency of the installation and the collaboration of the shipping company with the user of the shed, which are in fact under the same direction. It is certain that a similar installation at Tamatave over the length of an ordinary quay used by a large number of different companies and exploited by an independent stevedore would not give the same service. Furthermore, the Director of Technical Services of the Port of Antwerp, despite this particular example which is definitely a credit to the port, remains with his French and German colleagues, and for the same reasons, an advocate of the single storey shed.

The maximum return obtainable from a general quay.

The return of a general cargo quay, which is the mean annual amount of goods handled in tons over the total length of the quay, depends upon and is limited by the return of each item of handling equipment. For example, the operations of classifying, stowing and documenting the entry and despatch of merchandise are slower than the operations of loading or discharging by quayside crane or ship's derricks.

The construction and equipment of a new quay 300-m. long at Tamatave should assure that the port will be able to deal with an increase of general traffic of some 300,000-tons over a period of 20 consecutive years. This increase to some extent would be due to the opening of the Pangalanes Canal and to the development of the territory. There will then be an annual traffic figure for the port of 700,000-tons. The present quays handled 371,236-tons in 1955, divided as follows:

Quay	Length m.	Depth of water m.	Goods handled per year tons	No. of days occupied	Average output per day tons
A West	200	5.20	94,829	425	223
A East	100	8.5	113,304	288	393
B	170	9.00	163,103	321	508

It is worthy of remark that Quays A and B have yields of 1,133-tons and 940-tons respectively per annum per metre length of quay, which are high compared with other world ports where 600-tons is considered satisfactory. In comparison, 1,000-tons per annum per metre are handled at the Basin Leopold, Antwerp.

Consider Quay B worked by 8 gangs, 5 of them with carnes and 3 with ships derricks. The time spent in slinging a pallet is 5 minutes representing 12 pallets per hour. This is a maximum figure and should be reduced by 33 per cent to allow for weather hold-up etc., leaving 8 pallets an hour. When loading sacks, the pallet weight is 1.6-tons and the hourly yield for the 8 gangs would then be 102.4-tons. When discharging general goods, the weight is 0.7-tons giving an hourly yield of 44.8-tons. With flour, cement, metal, etc. mean weight is 1-ton, giving an hourly yield of 64-tons.

Of the 200,000-tons which, it is estimated will be handled at each berth of the new quay, the division of the cargoes will probably be imports 125,000-tons and exports 75,000 tons, for which the hours of handling will be:

Export	75,000/102.4	=	732 hours
Import	125,000-tons of which 75,000/44.8	=	1,674 hours
	and 50,000/64	=	782 hours
	Total		3,188 hours

representing over 300 days a mean daily duration of work of ten to eleven hours, which is compatible with the usages of the port.

It is therefore necessary to equip the new quay to handle a maximum traffic of 400,000-tons for the two berths which, if achieved, would represent the very high yield of 1,333-tons/per/year/per metre of quay length. Of the 400,000-tons handled over the length of the quay, it is estimated that the total export, say 150,000-tons will pass through the sheds, and that only two thirds of the imports, say 165,000-tons will do likewise.

Bearing in mind the operations inside the shed, the following intensity of floor load appears good practice for mixed goods—5-cwt. per sq. m. export, bags 1-ton per sq. m. This is based on the assumption of the following franchises, export-5 days, import-7 days. (The existing franchise of 11 days at Tamatave is excessive.) Given these conditions, the surface necessary for the stowage of exports over 300 days is

$$150{,}000 = Se \times 300/5 \times 1$$
$$Se = 2{,}500\text{-sq. m.}$$

Similarly for the stowage of imported goods

$$165{,}000 = Si \times 300/7 \times 0.25$$
$$Si = 15{,}400\text{-sq. m.}$$

Adding both Se and Si together = 17,900-sq. m. as the area of the shed required. This surface area compares favourably with the dimensions of modern European transit sheds, i.e., 9,000-sq. m. per shed (per berth).

The mean storage yield of the above shed would be

$$315{,}000/18{,}000 = 17.5\text{-tons/sq. m.}$$

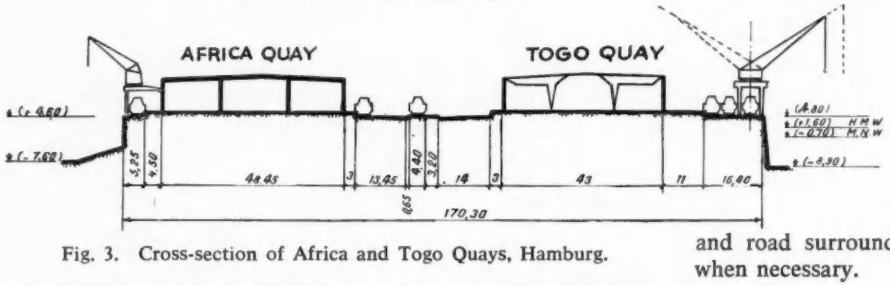


Fig. 3. Cross-section of Africa and Togo Quays, Hamburg.

It is worth noting that this is approximately the actual yield of Quay B.

Choice of the maximum linear dimensions of the shed.

So far it has been decided that the shed shall be single storey with area for each berth of 9,000-sq. m., and the next point to be decided is whether two separate sheds shall be constructed, or a twin shed with continuous floor and roof covering of 18,000-sq. m. Sheds of this type have been adopted in many of the recent European port development schemes. They permit elastic stacking conditions between the two berths and reduce transverse width.

For the projected sheds at Tamatave, if 1,000-sq. m. is added for garaging and servicing, sanitary accommodation etc., to the above, a floor area of 19,000-sq. m. is given, allowing for a shed 250-m. long by 76-m. wide.

The optimum lay-out of a quay surface.

The divisions of the quay areas depend essentially upon the assortment of the traffic between rail and road, on the stacking and distributing of the goods, on the importance of direct transfer from vessel to land vehicle or the reverse, and on the importance of direct transfer from vessel to land vehicle or the reverse, and on the importance of the intermediate storage, covered or uncovered. Every port has grown up in its own way and developed its own practice, therefore it is worth while examining the most recent of the measures adopted at Hamburg, Le Havre, Antwerp, Marseille and Dunkirk.

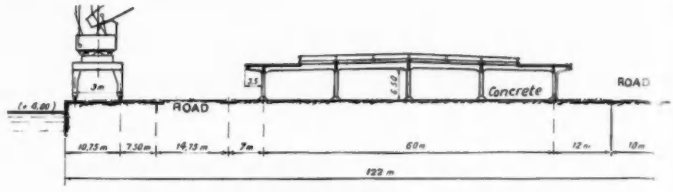


Fig. 4. Cross-section of Antwerp quay.

The general tendency in Europe is to increase the clear spaces about a shed, inside and out. The quayside crane occupies a most important role and the modern version with its flexibility makes for great efficiency.

a) **Hamburg Practice.**

Before the 1st World War it was the inland waterways which carried most of the traffic between the port of Hamburg and the Interior. Fig 3 shows the division of the Africa Quay surface at that time. There was a single line of rail in a paved strip 5.25-m. wide at the same level as the shed floor. At the rear of the shed there were 3 or 4 rail tracks for the trans-shipment of goods through the shed.

Between the two world wars and after the second, the change in the division of tonnages transhipped between ocean going and waterways vessels and the manner of transport to the Interior altered and affected the division of the quayside apron. The port engineers considered it essential to separate the rail and road traffic. The former, comprising three ballasted tracks, ran directly onto the quay (newly built Togo Quay, Fig. 3), while the latter was directed to a raised platform, the surface of which is continuous with the shed floor to the rear lorry loading bay on the roadway.

The outstanding feature of the Hamburg method is the complete separation of rail and road transport and the floor of the shed is raised everywhere above the quay level and road surrounds, but ramps are provided for lorry access when necessary.

b) **Practice at Antwerp and Dunkirk.**

Compared with the German practice, the Belgian solution is characterised by its flexibility whilst recognising the advantages of devoting special areas to different operations; the Belgians nevertheless only use the principle of specialisation when it does not pay to do otherwise. All sheds have floor levels flush with the surrounding surfaces. All rail tracks are incorporated in the roadways and vehicles or other handling equipment have access to the sheds. The simplicity of the arrangement is obvious from Fig. 4.

The flat continuous surface around and inside the shed has as a consequence an absence of platforms and loading bays for lorries. However, man-handling has lost importance now that cargo handling equipment is universal and, in addition to the

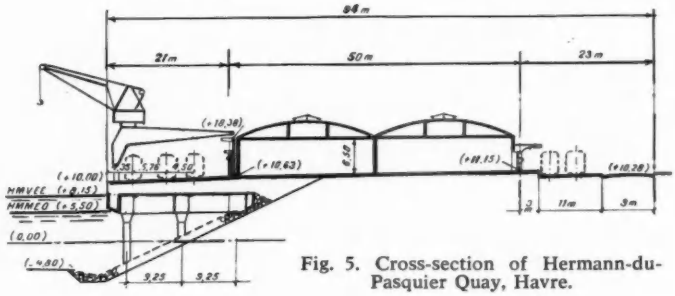


Fig. 5. Cross-section of Hermann-du-Pasquier Quay, Havre.

reduction in capital cost, the overall uniformity of quay surface facilitates mechanical handling.

c) **French Practice.**

The achievement of flexibility is perhaps the French port engineers' chief concern. In nearly all recent construction the floor of the shed is continuous with the quayside apron (See Fig. 5) and inclined gently downwards from the rear of the shed and thence to the edge of the quay. The transverse inclination in the shed is usually less, from rear to front wall, than it is from the latter to the quay edge. Rail racks are sunk into the paved apron to allow free movement of lorries and mechanical equipment.

The loading platform at the rear of the shed appears in all instances, built so that the floors of the vehicles and platform are at the same level.

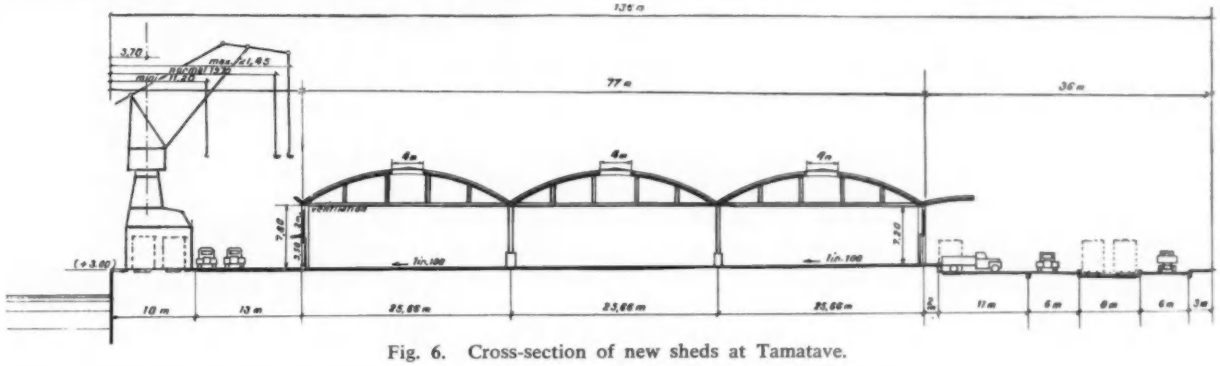


Fig. 6. Cross-section of new sheds at Tamatave.

d) **Comparison of solutions with reference to Tamatave.**

It is difficult to decide a priori that any solution is better than another. It is necessary to compare all the factors, bearing in mind also the customs and traditions of each port and the mentality of the users. For the purposes of this discussion, the examples of Hamburg, Antwerp and Le Havre are cited.

The most obvious tendency common to the three types is that of the maximum extension of manoeuvring space in front, through and behind the shed. With the choice lying between the rigidity of the German and the flexibility of the French and Belgian quay layouts, the Author favours the latter. The French solution is recommended for Tamatave where the floor of the shed is continuous with the quayside apron, the surface rising from the quay edge to the shed facade wall and transversally across the shed to the rear wall at an inclination of 1 : 100 to form a loading platform 2 m. wide for both road and rail transport.

The distance of the shed wall from the quay face is dependent upon the required crane radius which is 17.75-m. max., but for usual service 16-m. The axis of crane pivot is 3.70 m. from the quay face; the weather canopy projecting over the doorway 1 m. wide. A pallet of 4-sq. m. has a virtual radius of 1.50-m. and it is therefore prudent to allow 1-m. clearance. In view of this the shed should be at a minimum distance of 23-m. from the quay face.

This figure is less than at Hamburg and Antwerp but is in accord with French practice, allowing 10-m. for double line of track, 3-m. for single file standing for vehicles, and 3-m. for roadway one way traffic, leaving a 7-m. strip alongside the shed wall for sorting or re-stowing.

At the rear of the shed 11-m. is allowed for the width of the standing for loading lorries and provision is made for a future rail track alongside the loading platform if required. Beyond the standing for lorries a double roadway separated by a double rail ballasted track required a further width of 20-m. and, as shown in Fig. 6, a footwalk 3-m. wide. On each side of this shed there is a roadway for one way traffic.

Design of the Shed.

At Marseille the new single storey sheds in the Wilson Basin are of steel construction in light sections and standardised design. Heavy steel construction has been used for shed J.4 in the Joliette Basin.

At Le Havre, Dunkirk, Antwerp and Hamburg sheds have been designed and constructed of light reinforced concrete and, with the exception of the building at Antwerp, they have used arched roofing.

At Antwerp and Hamburg pre-fabricated elements of reinforced concrete have been incorporated into the construction.

a) **Floor-covering of sheds.**

The sheds of the A.M.I. at Antwerp are covered with large reinforced concrete slabs bedded on sand. They are 2-m. square and 10-cm. thick and framed in angles 45-mm. x 45-mm., strongly anchored into the body. In the manufacture, the frame is placed in the mould flush with the top surface, which is a layer of special concrete 10-mm. thick containing 10-kilos of iron filings per sq. m. of slab surface. These slabs give excellent service, close inspection has not revealed any crack, spalling at the corners or loose iron framing and very little irregularity in the rolling surface. In fact they have been sufficiently satisfactory to promote their use for the outside paving too.

At Hamburg it has been considered that the best results are obtained by the use of wood for paving inside the shed as it does not encourage condensation of moisture in a humid atmosphere. Wood is also used to pave the raised platforms outside the shed. Lately the port engineers have laid areas of concrete slabs 1.50-m. cq. by 12-cm. thick and they are also experimenting with rubber asphalt.

b) **Wall Openings of a shed.**

The modern tendency is to increase the number of the openings in the gable walls.

Port	% of wall length	Height	Width	
Marseille		5-m.	4-m.	quayside
No. 18	33%	4-m.	4-m.	rear
Le Havre				
Hermann du	100%	4.50-m.		quayside
Pasquier		3.50-m.		rear
Antwerp				
A.M.I.	50%	4.20-m.	4-m.	
Hamburg				
Sheds 55 & 56	100%			quayside
	50%	3.50-m.	3.50-m.	rear
Sheds 57 & 58	50%	3.50-m.	3.50-m.	
Shed gables		4.50-m.	4.50-m.	

Design of a Quayside Shed—continued

The continuous openings present advantages more theoretical than real, in actual use some doors are seldom, if ever, opened. Generally 33% of the linear wall length for openings has given satisfaction and is less subjected to damage.

It was therefore decided at Tamatave to have openings up to 35 per cent, i.e., openings 3.50-m. wide at 10-m. centres and height of 3.50-m. For the gables, openings 4.50-m. height and 4.50-m. wide.

c) **Height from Floor to lowest tie-beam.**

In Shed No. 18 at Marseille, the free height to the underside of tie beam of roof truss is 8-m. At Le Havre, it is 6.02-m. in sheds Hermann Pasquier and 5-m. in the new cotton sheds. At Antwerp it is 8-m. in the A.M.I. shed and at Hamburg it is 6.50-m. in all the new sheds. Additions to height are not costly and the extra improvement to natural lighting and ventilation is an advantage.

In these days of fork lift trucks, it assists the users of the shed to reduce the obstructions on the floor to a minimum and, for this reason, in wide sheds the spans of the roof trusses are carefully considered from the economic angle. For example:

At Marseille No. 18 shed 76-m. in width is divided into two spans of 38-m. longitudinal spacing of supports (central) at 8-m. centres. In the Wilson Basin the truss span is 40-m. wall to wall; at Le Havre, Hermann du Pasquier quay sheds, 50-m. wide in two arched spans of 25-m. and central support; at Hamburg, sheds Nos. 55 and 56 in reinforced concrete 48.50-m. wide, in three spans 15-m., 18.50-m. and 15-m. respectively spaced longitudinally at 9-m. centres. Shed No. 57 is of timber framing, 43-m. wide in two spans of 21.10-m. each, longitudinal spacing 10-m.

d) **Lighting of the Shed.**

Natural lighting in sheds is obtained mainly by windows in the upper part of the side walls. At Marseille the windows are 4-m. in height. With a single span roof truss they are on one side only, but for two or more spans they are on both side walls. At Hamburg, sheds Nos. 55 and 56 of 48-m. span, the windows are 3.50-m. in height at the front wall and 3.0-m. at the rear.

The lighting at Marseille is not sufficient although it is a great improvement on the double storey shed lighting. Hamburg lighting is good and at Le Havre, where they have continuous roof lighting, the light is vertical and uniform and is satisfactory. Recent sheds at Antwerp have been fitted with transverse strips of lighting which combine with side windows. This too is good.

When deciding upon the lighting at Tamatave, the climate was considered an important factor. At noon the light is vertical, the sky is clear and the sunlight strong. Skylights are therefore unnecessary and inadvisable because of risks due to the sun's rays passing through glass upon inflammable material. On the other hand, windows should not be too high as personnel subjected to a brilliant light soon become fatigued and, in addition, high windows are liable to sustain damage from cyclonic winds. The windows are therefore limited to bands of a height of 1.50-m. to 2.00-m.

The question of artificial lighting is more simple; in Europe 15 to 25 candle power per square metre is considered ample, (25 cp. at the source and 15 between sources). At Hamburg the intensity of the incandescent lighting is assured by means of lamps placed at 7-m. height, of which the power is 2-W. per square metre of floor; on the outside of the shed, particularly on the quayside, the projectors are placed on steel towers. To ensure that half the lighting power of the source, at the foot of the tower, will illuminate the quay, the height of the source must be 13.30-m. To obtain on the shed apron a lighting that will be equal to that in the shed, say 20 candle power, will require about 26.6-W. per linear metre of quay. This can be replaced by fluorescent lighting to give a natural effect.

e) **Fire Hazards and Ventilation.**

In Europe there does not appear to be any particular arrangement for the ventilation, except in the cotton sheds at Le Havre where the roof carries vents and skylights positioned to localise any fire by acting as a chimney.

It is not intended to take any special measures for this hazard at Tamatave.

f) **Sliding Doors.**

In Europe metal sliding doors are preferred to timber. When unbolted the door should open freely of its own accord and stay open. For this a slight counter inclination should suffice.

The severe rain storms at Tamatave require special precautions since the precipitation is 4-mm. per min. For this reason, lintel height canopies must be supplied at all openings whether glass panelled or not.

g) **Appliances.**

For the Tamatave shed, garage space will be required for the machines used at the rate of 2 fork lift trucks per gang, and a reserve of one fork lift per group of 4 gangs, that is, 40 fork lifts for two sheds. In addition, 6 gangways are required for the loading of lorries, and space has to be provided for 2 shed cranes, 4 tractors and 20 trailers. The total area required amounts to 600 sq. m. There remains the need for space for a servicing workshop.

Conclusions.

In the author's opinion, when designing quayside sheds, the engineer must guard against two main dangers: (1) anxiety to preserve the homogeneity of port installations by reproducing tried solutions. No matter how satisfactory existing solutions are, each new project provides the opportunity for improvement; (2) the purely deductive method which consists of straining reality so as to form a mould for principles which are, for the most part, preconceived ideas, as was for example the Author's first preference for the 2-storey shed.

Crane Replacement Programme at Parkeston Quay.

The first stage in the task of replacing 31 wharf cranes at Parkeston Quay, Harwich, will be undertaken by British Railways during 1960. The full complement of cranes at present in use is as follows: East Quay, twelve 30-cwt. cranes installed 1930; five 5-ton (1930); one 5-ton(1907); one 30-ton (1893). West Quay, three 5-ton and nine 30-cwt. (1934). Ten of these cranes—three 5-ton and seven 30-cwt.—are included in the first stage of the scheme. They will be replaced by two 10-ton cranes, three 7/7½-ton and five 3-ton cranes.

During the past ten years, the numbers of accompanied cars and loaded containers handled at the Quay have both doubled, rising in 1958 to 18,478 and 10,587 respectively. Moreover, the current level of cargo tonnage is about one third higher than at the same time in 1958. This relatively sharp increase in traffic is partly due to faster cargo handling, arising from mechanisation and re-organisation of shore labour.

Ten-ton cranes are particularly necessary for the largest types of container being carried on the Rotterdam and Antwerp services. The quick and economical discharge of palletised traffic, often in units of about 20-cwt. also calls for cranes of higher capacity than the existing ones, and so do some of the heavier cars now being transported.

The new improvements at Parkeston Quay will facilitate faster handling of cargo en route for the Continent, although fewer cranes will be in use.

Simplification of Shipping Documents

Review of International Problem

(Specially Contributed)

All nations have an undisputed right to protect their own trading economics by means of subsidies, quantitative restrictions or selective tariffs, in any combination best suited to their particular needs. A merchant fleet operating under a national flag must necessarily be regarded as a projection of its indigenous national economic policy. Nevertheless, there is a growing realisation that self-interest is bound up in the common interest and much has been, and is being, accomplished in the way of harmonising tariffs and liberalising overseas trade by direct negotiation and through the medium of GATT to promote the freer flow of goods and services. The international shipping industry cannot participate directly in these inter-governmental approaches; its role is to convey the world's goods as cheaply and efficiently as possible whatever pattern or volume of commerce may develop through such contacts. There cannot be, of course, any absolute standard of efficient performance in the field of foreign commerce and, since ocean freight is only one item in the delivered cost of goods, the subsidising of uneconomic shipping services in order to keep freight within reasonable limits merely transfers the burden of high costs to the producers of the goods being shipped. The protection of a country's uneconomic merchant fleet by cargo preferences prevents other countries selling economic shipping services to her and to that extent prevents them buying that country's economic exports. Some measure of protection may be unavoidable; it may be determined on social, political or plainly strategic grounds; the problem is to limit it to a point where the national maritime fleets can compete on substantially equal terms so that there may be fair competition not merely nationally within fleets but internationally among them. Any other course will, in the long run, operate to a country's commercial disadvantage. It will lead to a position where countries without merchant fleets will feel that they are being discriminated against, by what appears to them as a unilateral fixing of freight levels, and will take retaliatory action. It will nullify the lowering of national barriers against the free flow of world trade.

Whilst paying full regard to the above considerations the international shipping industry can do much to improve operating efficiency in a world business by means of regular consultation where the technical problems of the industry can be ventilated. At present the machinery for such interchange of views is not sufficiently developed but, even so, opportunities of this kind are much more likely to produce results if the industry is organised to perform a commercial function and not a political one. The more liberal attitude towards trade must be extended into the field of sea transport itself if **economic** shipping services are to be available to the world at large and be acceptable to the nations which do not possess merchant fleets of their own.

Although the United States operates the world's largest State supported merchant fleet, in pursuance of the 1936 Merchant Marine Act, and ships of that flag have accordingly been able to pre-empt a good deal of the world's carrying business without the need actually to compete for it, it is remarkable and highly creditable to the United States shipping industry that so much original thinking and professional studies of **world** shipping problems should have come from that source. One of the most interesting of these studies concerning the simplification of ships' documentation, i.e. the mass of official paperwork involved in the port-to-port movement of a ship, has been sponsored by the Marine Exchange of San Francisco Bay Area, the Pacific American Association and the Pacific Foreign Trade Steamship Association, in co-operation with the School of World Business, San Francisco State College. This comprehensive work is valuable not only because of its intrinsic merit but because it points to the advantages in other directions which would accrue to the sea transport industry if its many administrative problems were regularly discussed in an international circle. Already the subject matter of this report has attracted widespread attention and a sub-commitee of the International Chamber of Shipping has been formed to recommend what action should be taken to bring about improvements so urgently needed.

The contrast between the complicated and costly system which the maritime industry has permitted to grow up over many decades, and even centuries, and what has been achieved in the way of simplification by the airlines in the course of 10 years or less, is displayed with dramatic effect in this report. It has been shown that the airlines have been able to satisfy all government requirements with about one tenth the number of documents required of ships operating on the same routes and calling at the same ports. In so doing, the airlines have avoided excessive interrogation of passengers and crew. While we are comparing air operations with sea operations it should be noted that there are several material differences in requirements. For instance, in the former case crew lists, passenger lists and cargo manifests (if any), are smaller. There is less likelihood of contraband, stowaways, crew desertion, plague risk and other contingencies which certain steamship documents are intended to cover. But when the tremendous number of separate reports are recalled, repeated interminably for each and every berthing of a vessel, and some of them on outsized sheets and in coloured inks, the disparity is still remarkable. For example the following table shows the number of documents covering vessel, crew, passengers and cargo, required to enter and clear a ship, compared with the documents needed to enter and clear an aircraft.

Port	No. of Documents required for Ship	No. of Documents required for Aircraft
New York	22	4
Yokohama	32	3
Honolulu	46	3
Sydney	23	2
London	21	4
Copenhagen ...	21	**NIL**

To preserve a sense of proportion, however, like should be compared with like. Airways are still concerned predominantly with passenger transport whereas ships in the main are the vehicle for conveyance of goods. There is a natural limit to what statistical information can suitably or reasonably be asked of persons; statistically they are undifferentiated. Of goods, however, a great deal of information may be required by governments who are understandably concerned about the effect of such commerce on their trading economics. A contention of shipowners is that this data is already embodied in the bills of lading and the cargo manifests and they are simply being required to analyse it in countless different ways and to provide wholly unreasonable numbers of copies of the result in order to suit the administrative convenience of all the different authorities encountered on a voyage. The mass of documentation furnished for the benefit of governments at ports of call can properly be demanded though it is costly for the shipowner to provide; collaboration might well result in it not being unduly costly. In the field of public health, however, declaration and scrutiny is vital; it is equally of benefit to carriers that they should assist precautions designed to check the spread of disease though these may sometimes appear excessive to the uninstructed layman.

Though comparison can be drawn between the documentation required of the international air carrier and that of the ocean vessel, there are obvious limitations, then, to such comparisons. Further study will undoubtedly demonstrate that some documents are unique and essential to ocean transport and cannot be compared with air. Nevertheless, ship documents can assuredly

Simplification of Shipping Documents—*continued*

be simplified, consolidated or standardised and the question may well be asked why no serious attempt to do so has so far been made although in a very short time the airline industry has been outstandingly successful in rationalising its own documentary processes. Emphasis on speed is much more pertinent to the air carriers because the time consumed in fufilling document requirements is a much greater percentage of the total transit time. The more impressed a passenger may be with the technological achievements of high speed flight the less indulgent he becomes towards bureaucratic delays. But documentation facilitation in the international airline industry has — from its conception in 1944 — existed primarily on the international level.

The airlines quickly realised that theirs was a mass medium of intercontinental transport and communication, speed was inherent to successful operation and a minimum of border-crossing formalities were essential to achieve high-speed transit. Accordingly, the International Civil Aviation Conference was convened in Chicago in 1944, for the purpose of initiating a programme of technical studies and to provide for the constitution of an International Civil Aviation Organisation which would have purely advisory and consultative functions so far as economic matters were concerned. Until the establishment of ICAO was ratified as a specialised agency of the United Nations Organisation in 1947 the technical studies recommended by the Conference were pursued under the aegis of a provisional body known as PICAO. An important part of these studies involved Customs Procedures and Manifests and the facilitation of documentation concerned therewith. It became apparent, however, that the streamlining of administrative processes in general was an essential prerequisite and several other related work studies would have to be taken into consideration, e.g.:

Landing at Customs Airports.
Applicability of Air Regulations.
Entry and Clearance Regulations.
Prevention of Spread of Diseases.
Search of Aircraft.
Customs Duty.
Documents carried in Aircraft.
International Standards and Recommended Practices.

Accordingly, a comprehensive " Facilitation " programme dealing primarily, but not wholly, with documentation was instituted as a separate division of PICAO. Concurrently with the developments of the Chicago Convention and PICAO came the creation of the International Air Transport Association, (IATA), an organisation of 76 airlines whose aims and objectives are to promote safe, regular, and economical air transport for the benefit of the people of the world, to foster air commerce and to study the problems connected therewith; to provide means for collaboration among air transport enterprises engaged directly or indirectly in the international air transport service; and to co-operate with ICAO and other international organisations.

It is clear that the mechanism of consultation is much more highly developed over the whole field of air transport than it is in the maritime industry. It has had need to be. Contacts between airlines and governments, nationally and internationlly, have had to be familiar and direct in order to achieve high speed transit over a complicated network of air corridors intersecting the territories of foreign states exercised by questions of strategic defence. There is a clearer understanding of operating problems on the part of governments who in most cases administer terminal facilities themselves through their Civil Aviation Departments. But at the same time the traffic does little more than touch the fringes of industrial and commercial trading activity. The overall organisation has undoubtedly been highly successful in promoting "facilitation," however, within the range of its application.

In contrast with the integrated structure of the air transport industry, the organisation of the more massive shipping industry is diffuse, amorphous and inchoate; and understandably so when we consider its origin and history. In the early days the merchant venturers carried their own goods for exchange in their own vessels and the first intimation of a vessel's departure was when it was seen to arrive at its destination. The whole world of international commerce has grown up around those beginnings, becoming ever more complex through the advent of the telegraph, the wireless and air mail. Yet much of the sturdy independence of the pioneer sea-carriers is reflected today in the clinging to traditional practices and the dislike and suspicion of over-elaborate organisation and government regulation. Much of this is to the good but a more unfortunate legacy is that throughout the entire industry too little is known by one section of the problems and requirements of another. For example, it may come as a surprise to many port authorities whose role is an intermediary one to know that shipowners are afflicted by so palpable a burden of superfluous documentation in satisfying government controls. In most cases it is none of their business and they have plenty of troubles of their own. On reading this report, however, they will recognise it for the costly, time consuming, often futile process that it is and will willingly co-operate in endeavours to reduce it, if it is in their province to do so.

But vexatious through current practice may be, the cost economics which might be secured through this particular form of " facilitation " are not likely to be enormous; port authorities may well argue that the policy of shipowners in respect to the Bill of Lading involve them in redundant work in the aggregate much more costly and harmful to commerce and which might be reduced or eliminated if there were a better appreciation of what was entailed.

It is becoming evident that the business of sea transport would benefit greatly through the opening up of a field of consultation at all levels, national and international. Association at international level is at present tenuous. The work of the Shipping Conferences—the principal channel of communication—is more narrowly construed than that of IATA and is more compartmentalised. Until the ratification of IMCO in January 1959 no counterpart organ of ICAO existed in the maritime field, but now that this has been remedied machinery should be set in motion to feed it with the properly digested information needed to give it purpose and direction. The fact that this machinery of consultation will necessarily be more cumbersome than that employed in air transport and will work correspondingly slowly would not render it less suited to the task it has to perform.

South African Harbour Improvements

Considerable progress has been made on the construction in Durban harbour. On the T jetty the shed at L berth has been completed, while work is in progress at M berth. Expenditure on the improvement is expected to amount to £2,500,000.

Work has been started on the foundations of M shed which is expected to be completed in May 1961. The shed will be a three-storey brick-faced building; the ground floor will consist of an airlock and engine room with space for cargo stacking, the first floor will accommodate staff and pre-cooling facilities for 4,300 tons, and has been so designed that the capacity of the pre-cooling chambers can be doubled at a later stage, and the third floor will house a passenger terminal.

The newly designed pre-cooling installations at D berth, Cape Town, and T jetty, Durban, incorporate fire-resisting features such as a concrete roof and floor, partitions between tunnels and metal sheathed doors, also automatic sprinkler systems and fire-doors in corridors and airlocks.

The Port of Glasgow

Review of Developments over the last 200 years

Specially Contributed

WHETHER the Clyde made Glasgow or Glasgow made the Clyde is a question that could be debated **ad infinitum.** Probably the answer is that each is complementary to the other!

When river developments were first seriously contemplated over 200 years ago the population of Glasgow was 25,000 and the water area of the harbour 2½ acres; the length of quayage was 262 yards and the river was so shallow in parts that only the smallest vessels of that period could make passage to and from Glasgow.

Today, the population of greater Glasgow has increased to over one million and the water area of the port to 375 acres; with the addition of land the Clyde Navigation Trust's estate extends to over 1,000 acres. There are 12½ miles of quays and the largest vessels can berth near the centre of the City.

Early Development

The development of the Port of Glasgow coincided with the commencement of the Industrial Revolution in the mid 18th century.

The preamble to the 1759 Act, which was applied for as a result of a report by John Smeaton, the engineer of the Eddystone Lighthouse, states that the river was then "so very shallow in several parts that boats, lighters, barges or other vessels could not pass to and from the city except in time of flood or high water at spring tides.". It therefore empowered the town council to cleanse, straighten, enlarge and improve it from Dumbuck Ford above Dumbarton to the bridge of Glasgow and to erect such locks, weirs, dams, cuts and other works as they deemed necessary for promoting the navigation—no dam to be lower down the river than Marlingford.

A right to levy dues for constructing and repairing the works thus authorised was also conferred, but it was provided that the duty and dues thereby authorised, after paying expenses, should be applied to rendering the river more navigable, improving its passage and making and repairing locks, weirs, and other works thereon, in enlarging and repairing the quay of Glasgow, and making the same more commodious, and to no other use or purpose. Various regulations were also made.

In 1768 John Golborne, of Chester was consulted, and on November 30th of that year he reported that the river was in a state of nature, and that there was not more than 2-ft. of water over the shoal at Kilpatrick Sands and each end of the Newshot Island. He recommended that the river should be contracted by jetties eight miles below Glasgow and deepened by dredging which he estimated would cost £8,640. He stated that the greatest obstacle was at Dumbuck Ford where the river divided itself into two channels and he recommended that a jetty should be extended over the south channel and the hard crust of gravel removed by dredging.

James Watt's Report.

By the adoption of these means he believed the river might be so deepened as to give a depth of 4-ft. or perhaps 5-ft. up to the Broomielaw at low water. A year later, viz in 1769, the town council obtained, in accordance with Golborne's recommendation, report from James Watt as to the declivity of the bed of the river from Broomielaw to Dumbuck Ford, by which at Hirst Ford in the harbour was 14-in., and at Dumbuck Ford 2-ft.

In 1770 a second Act of Parliament empowered the town council to make the river navigable from Dumbuck Ford to the bridge of Glasgow by the adoption of the means advised by Golborne to supersede the construction of the locks or dams which the first Act conditionally authorised: to repair and enlarge the quay at Glasgow on the north side of the river at the Broomielaw, and also to erect a sufficient quay on the south side of the river opposite that of Broomielaw; and to divide the river into three stages at the several places specified "for the more equitable payment of the rates and duties" granted by the Act of 1759.

It provided for the continued use of the ferry boats at Govan, Renfrew, and Erskine, free from payment of any tolls, rates and duties; and for compensation being made to Renfrew for any damage which might be done to its salmon fishing in the river.

In 1773 Golborne, who was employed to put into effect his own recommendations, contracted to make the channel of the river at Dumbuck 6-ft. 10-in. deep and 300-ft. wide at low water. He succeeded in deepening the river 10-in. more than he had undertaken to do and by 1775 had erected 117 jetties on both sides of the river. These jetties confined the river within narrow bounds so that vessels drawing more than 6-ft. of water were able to arrive at the Broomielaw at the height of the tide.

Deepening of Channel.

The improvement thus effected in the river channel, and the possibilities which that improvement opened up, seem to have impressed the town council of Glasgow with the belief that a large portion at least of the shipping trade of the city might be brought up to the Broomielaw direct, and that the relations between it and Port Glasgow might be considerably relaxed.

In 1761 Golborne was instructed by the town council to revisit the Clyde and report specially as to whether the depth of water at the Broomielaw could be so increased as to admit of vessels trading to England and Ireland. He then found that the channel at Dumbuck, which he had deepened in 1775 to 6-ft. 10-in. at low water, was, by the diversion of current consequent to his operation, no less than 14-ft. at low water and in some places from 20 to 22-ft. deep, and he furnished an estimate for bringing vessels drawing 7-ft. of water to the Broomielaw.

Eighteen years after Golborne had made his second report the town council requested John Rennie to report on the manner in which further improvements could be effected; and on his recommendation in August, 1779, some of the jetties were shortened, others lengthened, and low rubble walls were constructed from end to end of the jetties so as to secure a continuous uniform channel.

Of these jetties more than 200, varying in length from 50 to 550-ft., were constructed between Glasgow Bridge and Bowling and the land reclaimed from the river became the property of the frontager owners. Much of the land has since been reacquired by the Clyde Trustees at great cost to enable subsequent improvements of the navigation to be effected.

In 1806 the town council employed Thomas Telford to advise what should be done with a view to the still greater improvement of the navigation. He disapproved of the jetties projecting into the river from either bank and, concurring with Rennie, advised that the parallel dykes which that engineer had recommended should be completed and the river brought as far as possible to a uniform width. In his report dated May 24 he stated that on February 14 of that year a Liverpool vessel of 120-tons burden and drawing 8½-ft. of water had got up to the

Broomielaw with ordinary spring tide.

In 1811-12 a new element was introduced into the navigation of the Clyde by the appearance of the steamboat "Comet" constructed by Henry Bell of Helensburgh according to his designs. Though she drew only 4-ft. she was required to leave both Glasgow and Greenock at or near high water in order to prevent her grounding in the river. This enterprise, however, did not meet with financial success, but it was the forerunner of a mighty change and by 1818 pasengers steamers between Glasgow, Rothesay, Largs and Campeltown were running daily.

Discharge into Lighters.

Previous to 1818 no vessels engaged in foreign trade came up the river further than Greenock or Port Glasgow. Their cargoes were discharged into lighters by which they were carried to Glasgow. These lighters were sailed, rowed and poled up to Renfrew and were then towed up to the harbour by men or horses. The largest ship belonging at that time to either Glasgow or Greenock did not exceed 400 tons while 250 to 300 tons was the usual size. The largest lighter was about 60 tons.

By 1830 vessels drawing 14½-ft. were arriving at the Broomielaw and by 1847 the depth of water available there was 16 or 17-ft. at High Water Spring Tides.

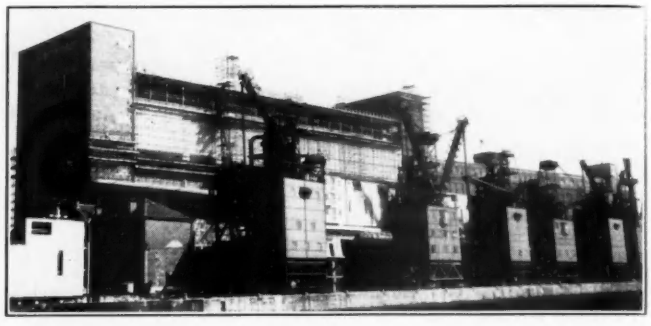
It was the Act of 1858 which placed the administration of the river and harbour under the Trustees of the Clyde Navigation as now constituted. It declared the limits of the Clyde to include the whole channel and waterway of the river forming the harbour, as far down as to a straight line drawn from the eastern end of Newark Castle on the south shore of the river, to the mouth of Cardross Burn on the north shore; the whole works

King George V Dock.

within these limits for the improvement of the navigation constructed or authorised to be constructed by the Trustees; and the whole lands acquired for the purpose of these works or occupied by the Trustees in connection with the navigation.

Additional Quayage, etc.

The depth of water continued to increase as did the demand for deep water berthage which at the middle of the 19th century was confined to the Broomielaw. Additional quays were built on both sides of the river and the first dock, Kingston Dock,



Meadowside Granary, showing extension on left nearing completion and in the foreground new grain elevator plant.

was completed in 1867. By 1876 the length of quayage had been increased to 3,587 yards. Other docks were built as follows:—

	Opened
Queen's Dock	1880
Prince's Dock	1897
Rothesay Dock	1907
King George V. Dock	1931

In addition, three graving docks were constructed and deep water berthage in the river provided.

Today the depth of water in the river ranges from 25-ft. in the lower reaches to 27½-ft. at King George V. Dock, these figures being at low water. To maintain and improve the depth the Trustees own and operate a large fleet of dredgers, barges and other craft.

During the last one hundred and fifty years £20 million have been spent by the Cylde Navigation Trust and their predecessors in creating and developing the Port of Glasgow, more than one-third of that amount since 1945. It is no mean achievement to have so widened and deepened a narrow, shallow stream as to enable the largest vessels to berth near the centre of a great city.

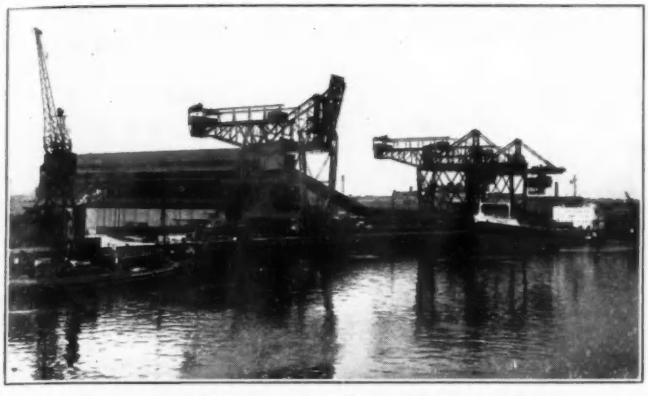
The Port of Glasgow today is a world port with 12½ miles of quayage equipped with excellent cranage, rail and other facilities. The Trustees also provide a modern granary (an extension of which is nearing completion), 20 acres of timber yards, an animals lairage with a roofed area of about 9 acres and transit depots for storage.

The Trustees, like their predecessors, are alive to the need for improving and extending the port. Since 1947 some 40 new cranes have been erected at a cost of approximately £1½ million and large sums have been spent in modernisation generally and in reconstruction work throughout the Harbour. Details of the major capital works which have either recently been completed and brought into use or are nearing completion are as follows:—

Meadowside Granary—New Grain Silo

Until the early days of this century most of Glasgow's imported grain arrived in bags which had to be off-loaded into sheds on the quayside and then lifted into carts for delivery. In 1914 the Trustees provided a granary of 35,000 tons' capacity with pneumatic elevators which allowed the grain to be sucked from the holds of the ships and stored in silos, thereby simplifying the loading of vehicles. An extension was opened in 1938 and the capacity of the granary was increased by 15,000 tons.

To provide for the further steady increase in grain imports largely brought about by the growing requirements for distilling and for the manufacture of feeding stuffs, the Clyde Navigation Trustees have under construction, at a cost of £4 million, a new 50,000-ton capacity grain silo at Meadowside adjoining their



Ore carrier " Edenmore " at General Terminus Quay.

existing 46,000-ton capacity granary thus more than doubling the granary capacity at the port. They are also providing six new travelling quayside suction elevators each with a discharging capacity of 200-tons per hour, increasing the discharging rate from ship to granary by four to five times the present rate.

The new silo which is a reinforced concrete brick-faced building, is 385-ft. long by 90-ft. wide, constructed on a reinforced concrete raft 4-ft. thick, founded on boulder clay, and consists of three main sections, the working houses, one at each end of the building, and the centre silo section containing the storage bins.

Eight Conveyor Bands.

The two nine-storey working houses are each 97-ft. wide by 35-ft. long by 187-ft. high and house the grain elevators, bulk weighing machines, dust extraction plant, etc., while the main silo section between the working houses, which is 315-ft. long by 90-ft. wide and 157-ft. high, contains 138 storage bins, generally of 400-tons capacity, 15-ft. square by 97-ft. deep; 12 of these bins are gas-tight for fumigation purposes.

On the floor over the bins and running the full length of the building, eight conveyor bands, each of 400-tons per hour capacity, distribute the grain to the bins, and on the first floor below the bins another conveyor band system delivers the grain to the bagging plants and can be used for turning over-heated grain. Provision is made for loading out into both road and rail transport, the ground floor being left open and paved for access by road vehicles and also by railway wagons on three lines of rail tracks longitudinally under the building.

An overhead gantry, carrying four conveyor bands each of 400-tons per hour capacity running parallel to the quay has been provided over three berths to permit the simultaneous discharge from three vessels, and overhead conveyor-band gantries are provided from the quay gantry to the east and west working houses of the new silo, also to the existing granary; in addition a conveyor-band gantry connects the new silo with the old granary at conveyor gallery level.

Machinery is provided for loading out in bulk to road vehicles and railway wagons from all bins via automatic weighers at the rate of 15-tons in seven minutes per bin and also for loading bagged grain to road and rail vehicles; in addition, by means of a dual-purpose band, bulk or sacked grain can be loaded out to vessels from the west end of the new silo.

When the extension of the granary is complete early next year the Port of Glasgow will be one of the fastest grain-handling ports—ship to granary—in the United Kingdom.

Shieldhall Riverside Quay Extension

A new deep water quay, 918-ft. long, has been constructed to give a dredged depth of 32-ft. at low water ordinary spring tides. The quay has been equipped with three 6-ton and two 10-ton electric travelling cranes, and adequate rail facilities have been installed to ensure rapid discharge and handling of either timber or mineral cargoes.

Immediately adjoining the new quay is Shieldhall Timber Yard, 13½ acres in extent with about 2 acres of sheds for the storage of valuable timbers and veneers. The whole area of the timber yard and the breast of the new quay have been paved in concrete to allow modern mechanical timber handling and stacking equipment to be used throughout.

The transfer of timber traffic to the new quay from the berths at King George V. Dock has freed these berths for additional general cargo handling.

The construction of the new quay, in addition to providing new deep water berthage, has added an additional 80-ft. to the width of the adjacent part of the river. The quay wall consists of a solid concrete superstructure supported on 30-ft. square monoliths with steel shoes built up on the site with pre-cast concrete blocks and sunk into position by loading with kentledge and grabbing out from the four wells formed in the monoliths.

The spaces between monoliths were sealed off at back and front with steel sheet piling and the spaces then grabbed out and filled with concrete. The paving of the quay and storage area consists of high grade mechanically vibrated concrete with a hard wearing surface layer of granite aggregate concrete.

Ore Handling Facilities at General Terminus Quay

To provide for the increased import of iron ore due to the establishment by Colvilles of their new steel works at Ravens-

Ore carrier arriving at General Terminus Quay with 19,217 tons of ore from Narvick.

craig and to achieve the most rapid turn-round of vessels, ore handling facilities have been provided at General Terminus Quay by Colvilles Limited designed to discharge simultaneously two 16,000-ton capacity vessels each about 530-ft. long. The

plant has been designed to handle an annual discharge of approximately 1.6 million tons with provision for future increase to over 2 million tons per annum. The plant consists of three 600-tons per hour transporters which grab the ore from the vessels and discharge on to belt conveyors which carry it to a 14,000-tons

New timber handling facilities at Shieldhall.

bunker system south of the quay. Four 300-cu. ft. scale cars receive the ore from the bunkers, weigh it, and pass it to the discharge hoppers below. It is then dropped into special 34-ton capacity wagons and a train load carries approximately 1,000-tons of ore on a shuttle service from the quay to the steel works.

To carry the very heavy loading on the quay wall from the transporters the quay was strengthened by the Clyde Navigational Trust for a length of 1,150-ft. by means of 4-in. diameter pre-stressed tie-rods of high tensile steel varying in length from 95 to 103-ft. each rod being designed to take a maximum load of 100-tons. The pre-stressing of the tie-rods was carried out by hydraulic jacks.

The tie-rods were anchored to a heavy beam supported on vertical and raking reinforced concrete piles driven at the back of the quay; this anchor beam also carries the back rail for the transporters. Subsequent to the quay strengthening, dredging was carried out to give a minimum depth at the quay of 36½-ft. at H.W.O.S.T.

The large transporters for unloading the ore from the vessels and feeding it on to the conveyor bands are mounted on a 75-ft. gauge rail track running the length of the quay. They are fitted with 10-ton capacity smooth jawed self trimming grabs with a 63-ft. outreach from the waterside rail. The hoisting speed of the grabs is 275-ft. per minute and the traversing speed of the grab trolley in bringing the loaded grab inshore over the belt conveyors is 500-ft. per minute. The overall height of the transporters is 139-ft. above rail level and the unladen weight 802-tons.

The installation has been very successful and the following are examples of the discharge rates which have been achieved:—On June 25th of this year the ore carrier "Biskopso" arrived at the quay at 4 a.m. with 15,000-tons. Between 8 a.m. and 9 p.m. 13,125-tons were unloaded i.e. over 1,000-tons per hour and the ship sailed at 3 p.m. on the following day.

The highest rate per transporter was acheived when the ore carrier "Redcar" discharged 13,905-tons in 10 hours on March 10/11th at an average rate per transporter of 695-tons per hour. Between 1 p.m. and 9 p.m. on March 10th the rate of discharge was 734-tons per hour per transporter.

Future Capital Works

Another project which the Trustees have already obtained powers to undertake involves the widening and deepening of the entrance to Queen's Dock so that larger vessels can be accommodated there and more easily manoeuvred.

The Trustees' development plans for the next 8 years or so should raise the capital outlays in the post war period to over £22 million.

Shipbuilding on the River.

The River Clyde is probably the best known shipbuilding river in the world. The Trustees are well aware of the need to meet the requirements of the shipbuilders within the area of their jurisdiction who, like other British shipbuilders, are faced with increased foreign competition.

A feature of post-war shipbuilding activity on the river, as elsewhere in the British Isles, has been the introduction of extensive programmes designed to modernise shipyard methods and plant so that ships can be built more quickly and therefore more economically.

The practice of building ships in sections and the advantages of fabricating these under cover has necessitated the erection of very large shops, well equipped with heavy-lift travelling cranes alongside the building berths.

Large sums have been spent in rearranging building berths for the construction of longer and "beamier" ships which is partly due to the increased demand for larger oil tankers.

Fluctuation in Trade.

Considerable changes in the pattern of trade of the Port have occurred since the beginning of the century. Before the 1914-18 War approximately 10,000,000-tons of goods were imported and exported each year. This total included some 4,000,000-tons of coal exported, traffic which has steadily declined since the 1930's to the low figure of 165,000-tons last year. Excluding coal, imports and exports acounted to 6,000,000-tons a year prior to 1914 and with a total in 1958 of 7,200,000-tons the overall position is not unfavourable, but these figures do not give any idea of the radical changes in the nature of the commodities handled at the port.

Queen's Dock and Prince's Dock.

Grain and feeding stuffs imported last year were at the record figure of 771,000-tons and further increases are looked for after the opening of the new granary in the early months of 1960. Oil and petrol also record very substantial increases from

100,000-tons a year at the beginning of the century to 2,000,000-tons today and here again further increases are confidently expected. Imports of iron ore reached the highest ever figure of just under 2,000,000-tons in 1958. The impressive new ore-handling plant of Messrs. Colvilles at General Terminus Quay and the Trustees' equipment at Rothesay Dock can together handle substantially greater quantities of ore and these should come forward with the recovery of the heavy industries and the construction of the new strip mill at Ravenscraig.

A most distressing feature of post-war trade has been the decline in traffic carried coastwise from 2,600,000-tons in 1913 to 1,100,000-tons in 1959. The experience of two world wars showed the need of a fleet of up-to-date coasters but the lesson appears to have been forgotten and this branch of shipping has been allowed to languish while traffics that are quite unsuitable continue to be carried on the country's road system.

Another significant change in shipping at the Port is shown in the tonnage of vessels arriving and departing—12,000,000-tons prior to 1913 and 15,000,000-tons today. Vessels have increased in size, not always with corresponding increases in cargoes carried. This, however, does not apply in the case of ore and grain where larger cargoes are being imported.

Summing up, it might be said that traffic responded well to expenditure on the Port until 1914, but since then it would appear as if the Trustees' New Works have only maintained traffic, not increased it. Grain and ore should help to remedy this situation in the near future.

The Clyde Navigation Trustees offer the most up-to-date facilities for handling grain at Meadowside, timber at Shieldhall, cattle at their animals lairage at Merklands and for storing cargoes in their transit depots at Braehead and Deanside. They are prepared to co-operate to the fullest extent with shipowners, stevedores and dock labour in making possible the use of cargo-handling equipment such as fork-lift trucks, pallets, timber-carriers, containers and the other appliances which a great seaport must possess.

The Port of Glasgow is not run for profit but for the benefit of those who use it and it receives no Government grant or other subsidy to assist its finances.

Throughout the pass 200 years of its existence it has never been slow to spend money on improvements where these could be shown to be needed. Today much of the recently invested capital is about to become revenue-producing and further developments should follow in due course.

Metallurgical Progress and the Dock and Harbour Engineer

by L. SANDERSON

Metallurgical progress resembles the growth of a plant in that it does not proceed in a smooth advancing curve, but in a series of sudden surges followed by periods of rest. During the last twelve months or so there have been a remarkable number of technical advances in metals and their application, corresponding to a period of rapid advance. In the following paragraphs an endeavour has been made to summarise those of direct or potential interest to the dock and harbour engineer.

Stronger Alloy Steels

The level of strength required of high alloy steel has steadily increased to a point at which steels designated originally for use at about 80 tons/sq.in. are now being heat-treated for applications at levels of strength amounting to about 116 tons/sq.in. This increase in strength is being generally effected by a reduction in the tempering temperature. Ductility and impact values formerly unacceptable are now being specified.

A new high strength steel has been developed which combines strength with ductility, especially in the extra-full-hard condition. It is a 17 per cent chromium, 6 per cent nickel, steel with controlled carbon and nitrogen.

An entirely different approach is the improvement of mechanical properties by severe deformation with ordinary steel-working equipment. The critical amount of deformation necessary for a marked increase in mechanical properties is of the order of 25 per cent reduction of area. The first 25 per cent of deformation is highly effective. Substantial increases in ultimate tensile strength and elongation have been noted at low tempering temperatures. Ultimate tensile strengths in the region of above 175 tons/sq.in with excellent ductility have been obtained on highly deformed medium carbon alloy steels. Hardness was substantially increased.

Explosive forming is a relatively new process. The requirements for it include a die, usually of steel; a shaped explosive charge; and a medium surrounding the charge to transmit the energy to the metal being formed. The advantages of the process are the high elongations and the absence of spring-back after forming. The process can produce forgings, welding, bonding, shearing and punching. Explosion extruding is also a feasible process.

Sudden catastrophic failures of large welded steel structures such as storage tanks, bridges, welded pressure vessels, etc., experienced between 1930 and 1945, have demanded an all-out effort by designers, welding engineers and metallurgists to determine the cause and to establish remedial procedures or solutions. The metallurgist has now developed steels with properties so modified that the notch-ductile-to-brittle transition characteristics of the steels used is below that of the expected temperature range of service. If steels of adequate notch ductility are not available, greater attention must be paid to design to reduce the probability of failure to acceptable levels. It is now established that welding may contribute notches, cracks or other flaws from a variety of causes, and these when present at points of high stress in steel of inadequate notch-ductility represent the combination that causes brittle fracture.

A significant advance this year is the development of a new process which makes available the widest thin-gauge stainless steel sheets ever produced. Made by the sandwich rolling of stainless steel between two carbon steel cover plates, the process offers many advantages. It is now possible to produce stainless steel sheets up to 120-in. wide—more than twice the width of light gauge sheets rolled by conventional methods. This size of sheet eliminates many seams and joints necessary in the fabrication of large surfaces from narrow sheets.

New Alloy Metals

An aluminium alloy has been introduced with unique mechanical properties, including exceptionally high elongation and impact strength and ability to sustain bending and deformation. Also new is a metal plating process which reduces plating operations to bare essentials, but is so effective that it transforms a thin layer of plating substance into an integral part of the base metal.

Maintenance on flashes, copings, gutters, skylights, etc., in buildings has been virtually eliminated by the development of a crimped high nickel copper alloy roofing material. This needs fewer seams, and virtually eliminates failure from the few seams that are needed. Moreover, its strength and ductility allow the employment of sheets lighter than other roofing materials, which means easier fabrication and installation. High nickel copper alloy has also proved valuable in load-lifting jack sleeves. It resists sea-water corrosion in 15-ton journal jacks. The material used is an age-hardened quality of nickel copper alloy having high tensile strength.

The most powerful harbour tug in the United States found that compression was being lost, and power with it, by the pounding and wearing out of shape of piston ring grooves. To overcome this trouble, a ring carrier band is now inserted in the top grooves. Made of corrosion-resistant nickel chromium alloy cast iron, this band strengthens the grooves by withstanding heat, pressure and all the hard wear.

Yet another development is the electric signal horn, which is designed to produce a raucous noice. To produce this noise, an armature hammers a thin metal diaphragm 300 times a second. The corrosive marine atmosphere is withstood by the nickel chromium alloy of which the diaphragm is now made.

A stainless steel that is buoyant in water has been developed. So has a new metal which is said to resemble a petrified sponge, but to be nine times lighter. There is also a new metal alloy process which involves mixing ceramic materials with metals, thereby making the metallic alloys three to four times as strong as ordinary metals at elevated temperatures, it is claimed.

The protection of the Port of New York's new 8¼ million dollar Pier 11 in Brooklyn is achieved by the fact that its 270,000 sq. ft. of covered space is provided with an automatic sprinkler system. The sprinkler heads were made after alloys had been tested by continuous overloading for three years, after which they were exposed to elevated temperatures, and finally in hydrochloric and nitric acid fumes, chlorine fumes and salt spray. From this severe test it was found that a nickel chromium alloy was the best for the valve disc which opens free under water pressure; while high nickel copper alloy was the best for the yoke. High strength nickel alloy steel is being freely employed wherever the stresses on structural shapes are most severe and where castings are exposed to atmospheric corrosion, as in the St. Lawrence Seaway, where the cast steel track girders and segment girders for the rolling lift bridge at Iroquoise Point weigh as much as 14 tons.

Today, large construction jobs, such as bridges, large warehouses and elevated roadways, are being completed faster than ever before. One technique developed for this purpose is ground assembly. This means putting sections of girder assemblies on the ground, then lifting them into place. This greatly reduces the work required high up on the structure, so cutting time and cost. To lift these giant assemblies, girder dogs are used, which are three-piece units made up of two hooks or dogs held together by a ring, and sometimes nearly 6-ft. in height. The most critical point in the three-piece assembly is the ring, and for this reason a nickel chromium molybdenum steel ring casting, normalised and tempered, is being used in some instances. The steel contains 2 per cent nickel, 0.9 per cent chromium, 0.8 per cent manganese, with molybdenum and silicon. It has a tensile strength of about 51 tons/sq.in., yield strength 40 tons/sq.in. and elongation 21 per cent.

Corrosion of Structural Materials

To determine the general corrosion behaviour of various structural materials when exposed to harbour sea water, sixteen metals, alloys and steels were totally immersed in the water of a large harbour for periods ranging from 6 to 30 months. Magnesium base alloys were the most readily attacked, while lead showed the greatest resistance to corrosion. Corrosion on aluminium alloys was mainly in the form of pitting. High nickel copper alloy and 18-8 stainless steel also showed this type of attack, but otherwise the surface remained smooth and apparently free from attack. Copper, brasses and bronzes corroded only slightly, with no signs of pitting. The carbon steel tested rapidly corroded.

The corrosion of carbon steel piles used in sea-water installations has been found to be most severe in the "splash zone." Investigations having indicated that low alloy, nickel-copper-phosphorus steels showed higher resistance to corrosion under these conditions, tests have been carried out to compare the two materials in this respect. It has, as a result, been conclusively proved that the nickel-copper-phosphorus steels are, as a class, much more resistant than the carbon steel to splash-zone conditions. The best results were obtained with a steel containing nickel 0.5, copper 0.5, phosphorus 0.012, per cent. The resistance of this material to pitting was at least three times as great as that of the carbon steel. As regards atmospheric corrosion, the weight loss of the alloy steel was only 5 per cent that of the carbon steel.

Since 1946 an extensive investigation has been in progress to determine the corrosion-resisting properties of 50 metals and alloys exposed to five tropical environments: marine and inland atmospheres, fresh water immersion, and continuous and mean tide sea-water conditions. The conclusion drawn is that low alloy additions have no great value in increasing the corrosion resistance of steels immersed in sea water; the harmful effects of some alloying elements, which developed after long periods of exposure in these tropical environments, were, however, unexpected. Among these elements were 2 to 5 per cent nickel and 3 to 5 per cent chromium.

Cathodic Protection

Cathodic protection of bridge steelwork is being adopted. A survey of a large West African harbour showed that extensive corrosion of the bridge steelwork had occurred. To prevent future corrosion it has been decided to protect the bridge by a cathodic system consisting of 240 graphite anodes sited on the downstream side of the existing bridge. The anodes are 2½-in. in diameter. Current will be taken to the anodes by cables sheathed with a plastic material. It is expected that the anodes will last for 15 years.

Cathodic protection is also being used in the Persian Gulf to protect the steel piles of an oil-loading jetty. The cathodic protection system here consisted originally of magnesium anodes placed on the sea bed with a wire from them to an insulated connection on the pier, and thence to a resistance for current control. Finally, the wire was earthed to the structure. The new system used applies D.C., 16 metal plate rectifiers, each with an output of 150 amps of 50 volts. Sacrificial anodes of about 8 tons weight are being used for the approach piers, while for the oil and cargo piers, one-ton anodes are located among the piling. This new system is expected to save enormously in running costs.

Recent Developments

Ductile iron is being applied to the valves handling crude oil in dockside piping. The iron was chosen for these valves because it combined economy and corrosion resistance, as in cast iron, with much better resistance to shock, together with the strength of steel. The valves are subject to hydraulic shock when lines are shut off, and the iron is tough and strong enough to take this sudden stress without failure. It has also a good resistance to thermal shock, a safety factor in case of fire.

A significant development, recently announced, is the welding of similar or dissimilar metals by vibratory energy produced by magnetostriction. The pieces to be united are clamped between two elements, and intense vibratory energy is introduced from a transducer. The result is a solid-state metallurgical union, with low deformation and no fusion. This method is especially useful when it is desired to unite extremely thin sheets to heavy sections, a difficult task with fusion welding. Magnetostriction is the change in dimension some ferromagnetic materials undergo when placed in a magnetic field.

Developments in Lighthouse Engineering

Review of Recent Innovations

by K. C. SUTTON-JONES (Stone-Chance Ltd.)

ENGINEERING science has been applied to lighthouses and aids to navigation for many centuries: Smeatons famous tower erected on Eddystone in 1759 was equipped with a candelabra of 24 candles and whilst crude reflectors and oil lamps marked the early stage of development, no real progress appeared until Fresnel introduced his annular lens in 1813. Since then, many ingenious methods of collecting and distributing light have been devised and oil wick burners, mantle burners and mantle pressure burners were introduced culminating in the system illustrated in Fig. 1, which was in vogue for many decades. In this system the light from the paraffin mantle burner was collected most efficiently by the lens and concentrated into horizontal spokes of light which, when rotated, passed the observer as a code of flashes, thus identifying the lighthouse. Many of these lenses were 9-ft. in diameter and very heavy, necessitating a low friction pivot in the form of a mercury trough and float which would be capable of being rotated by a hand-rewound weight-driven mechanism.

The introduction of electricity and the Tungsten filament lamp has caused a radical change in approach to lighthouse illumination and a number of recent instances are discussed below.

1. Attended lighthouse in the Tropics located many miles from the servicing depot and **where electric supply** is not available.

The paraffin mantle installation had a brightness of only 49 candles/cm^2 whereas the electric filament is usually of the order of 600 candles/cm^2. Accordingly the lens needed to produce a million candlepower is much smaller than its oil burning counterpart and is suitable for rotating upon ball bearings (See Fig. 2). These bearings can be replaced within half an hour without removing the lens in the unlikely event of a bearing seizing. The method of rotation is still the weight driven machine which can control the speed of rotation to within 1% of nominal but the mechanism is rewound automatically by a small motor reduction gear unit with a free wheel built in to avoid damage if the motor fails to stop. Starting and stopping is arranged by limit switches operated by the rising and falling weights.

The illuminant is duplicated by the provision of an automatic lampchanger arranged to interchange the lamps and kindle the lamp in focus in the event of lamp failure.

In a case where the lightstation is less remote, as in a number of recent Trinity House re-equipments, the lens would be rotated by one of two motors which can be changed automatically in the event of the service unit failing,—the means of rotation in an extreme condition of supply failure being by hand (See Fig. 3). However, at remote stations (including those in Scotland and the outer Isles) the weight driven machine is employed, providing powered means of rotation in such an emergency. Similarly, the lampchanger can be unplugged, removed and replaced by an oil mantle pressure burner.

In such a remote locality, the system of electric control is devised to be operated by unskilled local staff and maintained by a mechanic visiting once every three months. This system is in use on some forty lighthouses in tropical locations in the Far East, West Africa and the West Indies.

Three diesel engine driven power plants are employed, any one of which supplies power for the lighting apparatus and keepers dwelling. Thus, even if one plant were being overhauled—there are still main and standby power plants available for duty and the three plants operating in sequence render wear in any one plant extremely small and decarbonising is necessary only once per annum.

The plants are started and stopped electrically by special switches and means are introduced so that paralleling of the supplies from two or three plants is impossible. The starter battery is large and capable of giving repeated starting duty but is recharged automatically from windings on the machine after starting.

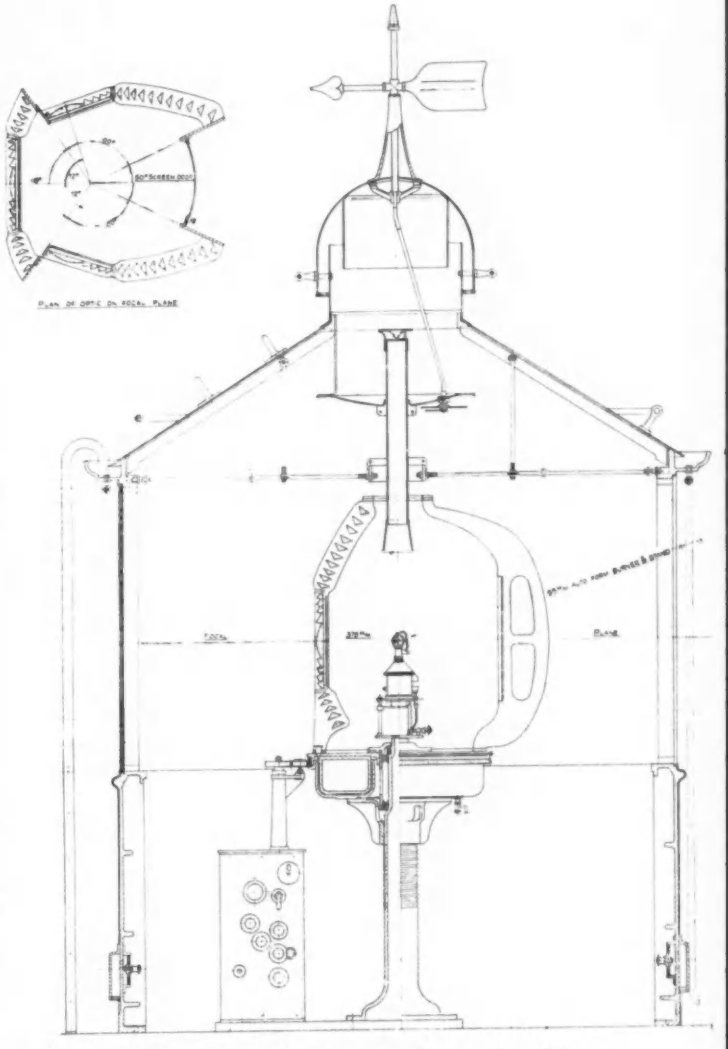


Fig. 1. Lighthouse optical apparatus with mantle oil burner illuminant.

Detection relays are incorporated so that in the event of an overload developing, lubricating oil pressure being insufficient, or the radiator over-heating—the plant is shut down automatically and the alarm sounded continuously until the keeper has restored the supply to the lantern by starting a second plant. The cause of failure is recorded on an indicator for the guidance of the visiting engineer and cannot be reset by the keeper who

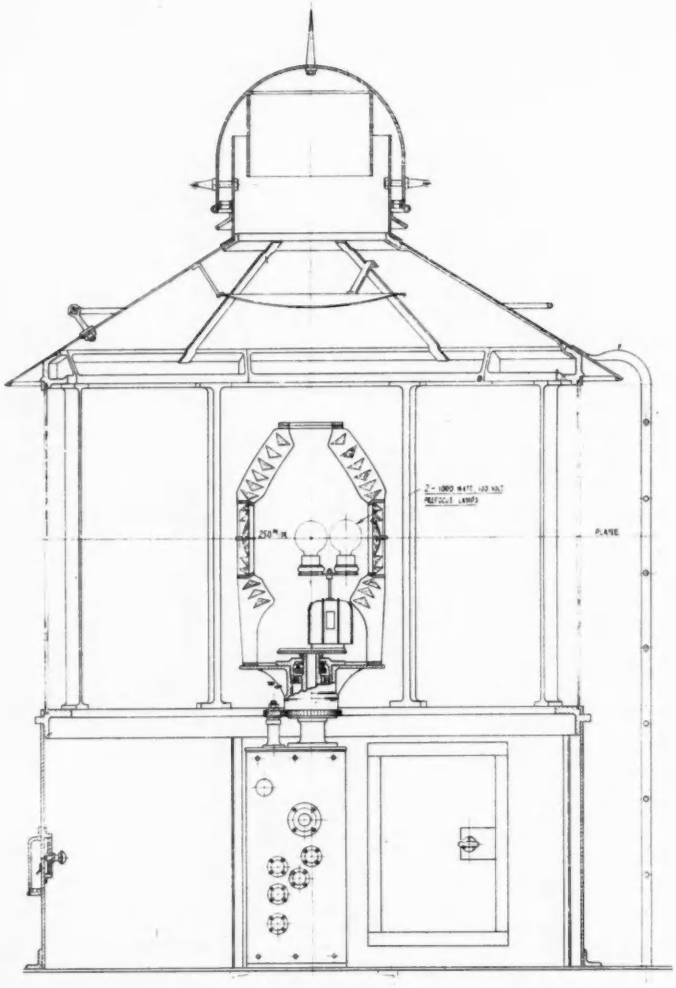


Fig 2. Lighthouse optical apparatus with electric illuminant and weight-driven, electrically rewound rotating mechanism.

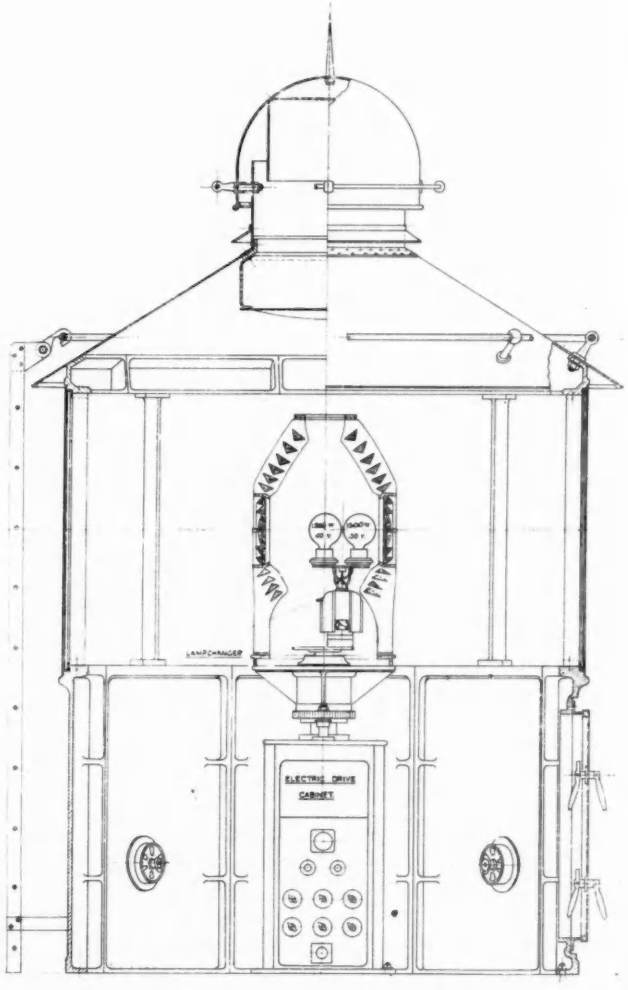


Fig. 3. Lighthouse optical apparatus with electric illuminant and motor-driven rotating mechanism.

has probably rectified the cause by attending to sump oil level etc.

This has been found to provide an effective inducement to careful light-keeping. Similar warnings are given in the event of a main lamp failing—the warning being operative until the keeper has replaced the faulty lamp. A further warning is given if the rewinder fails to lift the weights—the alarm being isolated only after the keeper has rewound the weights by the hand method. The above lightstations usually employ two or three attendants and the light functions automatically during the duty period without a watch being kept.

Where mains power supply is connected an engine alternator standby power plant comes into operation in the event of the supply failing and stops itself following restoration of the supply and after the starter battery has been recharged.

The above lightstations usually operate automatically, a caretaker sometimes being resident.

2. Attending Light-vessel:

Many light vessels are employed on a variety of stations where the lighting apparatus has to be suitable for modification to give one of several flashing characters. This is achieved by one of two methods.

(a) The multiphase lens in which panels or parts of a lens panel can be altered in position.

(b) The multicatoptric unit where eight mirrors with separate lightsources are set in pairs vertically so as to emit light in four beams—the separation axes of which are capable of variation to provide the different characters.

The mirrors are of electrolytically brightened anodised aluminium alloy and collect only about half the light emitted from the lamp. In some circumstances, additional de-centering mirrors are located in front of the lamps to spread the light horizontally so as to increase the length of flash but the system, whilst being the less expensive, is more wasteful in electric power. However, so much power is usually available that this system is generally considered to be the more economical.

Both the above systems employ a pendular apparatus originally of Trinity House design which maintains the focal plane of the apparatus on the horizon. The lens or multicatoptric unit is rotated by an electric motor located in the pendulum but in some instances where lenses have been installed a weight driven machine is used in an extreme emergency for effecting rotation whilst the oil mantle burner provides the means of illumination. In such circumstances however the pendulum is locked in its vertical position. These are illustrated in Fig. 4.

3. Unattended lighthouse with subsidiary sector light—The Fullerton Lighthouse, Singapore.

The original Fort Canning lighthouse was erected behind the City of Singapore and has, in recent years, become eclipsed in certain important directions by high modern buildings. It there-

fore became imperative to establish a new light on the roof of Fullerton Building which lies on the waterfront at Collier Quay.

Vessels proceed in an easterly direction past St. Johns Island and then turn into the roadstead. It was found desirable to have a conspicuous group flashing light and, to achieve this, a multicatoptric unit set to give white group flashing 4 flashes every 20 seconds was installed. This is mounted upon a turntable and rotated by a weight-driven machine with automatic rewinder. The candle power is 557,000 candelas (effective beam intensity through the lantern). However, this does not provide the defined sectors and to achieve this a subsidiary sector arrangement was installed giving fixed blank, green, white and red sectors.

Under certain circumstances it is desirable to arrange the focal plane heights of the main and subsidiary lights to give a set vertical separation so that the lights are always seen as two separate emissions. In this case however it was decided to make the lights blend so that the sector is defined by the colour of

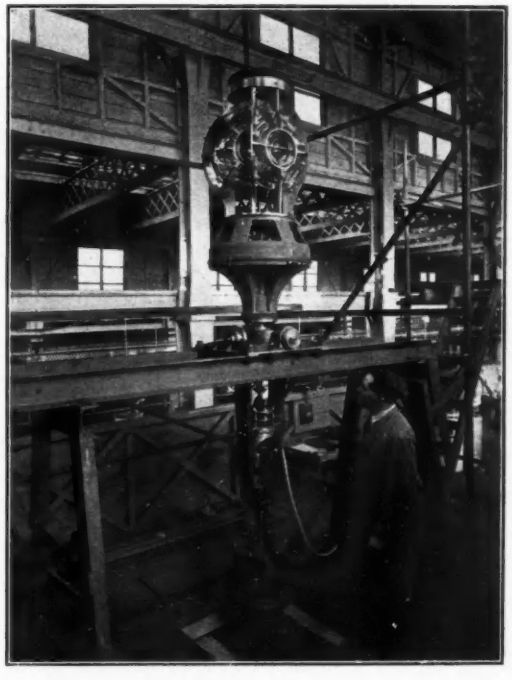


Fig. 4. Light-vessel optical apparatus with electric illuminant.

the fixed light appearing between the flashes of the main apparatus and in eclipse period. This has resulted in a very conspicuous aid.

The subsidiary sectors are given by a separate fixed lens mounted above the main apparatus in which a 500 watt, 100 volt lamp (identical with that located in each mirror) is mounted upon an automatic lampchanger with a standby lamp. Red and green colour filters are installed and sector sharpening screens and filters are mounted inside the lantern glass. Additional radial sector cut-off screens are installed screening stray light from becoming exhibited with the colour sectors.

The main and subsidiary lights are connected through a transformer to the mains supply. If this fails, a standby engine alternator plant starts automatically and restores the supply to the apparatus. Fig. 5 illustrates the lantern complete.

4. Attended lighthouse with fog signal:

Some very interesting problems had to be solved in connection with the provision of a completely new lighthouse tower at Inishtrahull Island off the north coast of Ireland. It was necessary that the light should be visible and the fog signal audible over a 360° horizon. The tower had to provide a good daymark so that the original proposals to mount the fog signal within an openwork tower were unacceptable. Accordingly, a concrete tower was erected and the light and fog signal were mounted on this—the fog signal forming an integral portion of the lantern

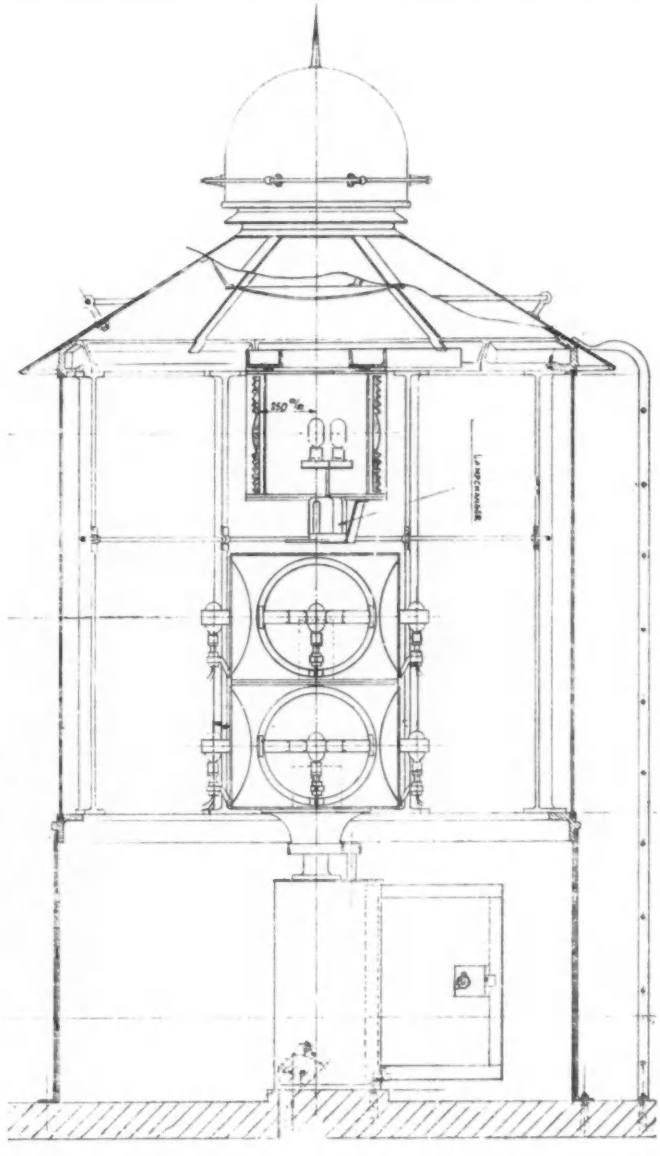


Fig. 5. Optical apparatus, Fullerton Lighthouse, Singapore.

roof. This introduced a completely new conception of lantern design, the features being as follows. (See Fig. 6.)

(a) Lighting apparatus: This is of multicatoptric type, each mirror subtending a 1,000 w. Class A.1 lamp derated so as to provide an average life of 1,000 hours. The mirrors are set in four pairs of two mirrors so as to give a single flash every 20-secs., of 1,750,000 candelas (effective intensity through the lantern glazing). The mirrors are rotated on ball thrust and journal bearings by one of two motors—centrifugal switches being included so that if one motor fails, an alarm sounds, and the other can be started. An emergency hand-turning gear is included. Automatic lamp failure alarms are included. The novel part of the design is that the air main for the fog signal is carried up through the pedestal-column of the lighting apparatus and thence

vertically through the centre of the optical assembly so that vision is in no way obscured by this piping.

(b) Fog signal: The diaphone is of the radial flow 'G' type whereby air is admitted at 35-lbs. per sq. in. pressure and reciprocates a piston in a cylinder both having circumferential slits. The emitted sound, caused by cutting the air approximately 180 times per second, is projected by an exponential double saucer shaped horn. This distributes sound throughout all horizontal directions.

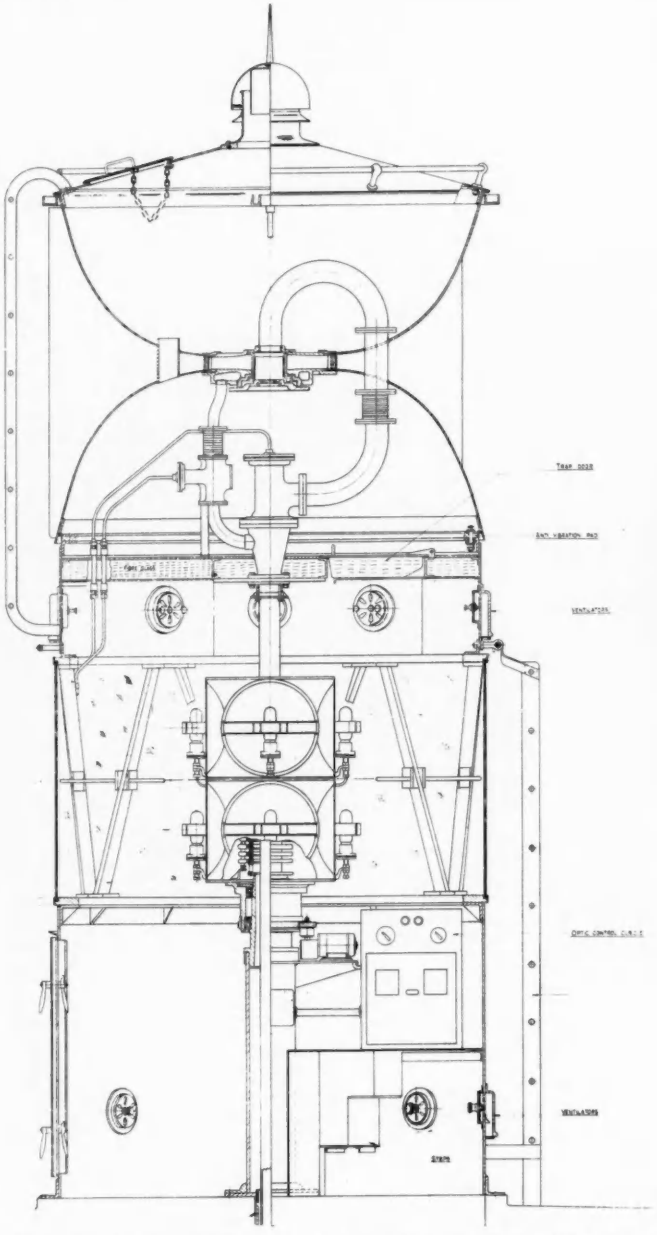


Fig. 6. Optical apparatus and fog signal, Inishtrahull Lighthouse.

(c) Lantern: The lantern was made in four units each of which were transported complete from Crawley to the site and lifted individually upon the completed tower. The lantern base (or murette) was of 5/16-in thick metallised steel. Upon this cylindrical base a complete lantern glazing unit having specially strengthened inclined steel framework was bolted surmounted in turn by a 12 sided trunking incorporating sound and temperature insulation material.

The horn was bolted complete on to the top of the ventilator trunking and formed the roof of the lantern. Very careful attention was given to access arrangements for servicing and protection to the components.

5. The next stage:

Following extensive work by the Research Department of Trinity House in conjunction with Stone-Chance Limited, lamp manufacturers and others, Xenon lamps are to be employed at the new Dungeness lighthouse. This lamp has a very much higher brightness than the Tungsten filament lamp so that a further reduction in lens size is achieved and rotating mechanism is dispensed with—the flashing character being derived by nigrescing the source of light. It should not be supposed however that revolving lenses are obsolescent for the very high candle powers may require them.

The most interesting aspect of this installation is that the lighthouse, with its fog signal, will operate automatically. This

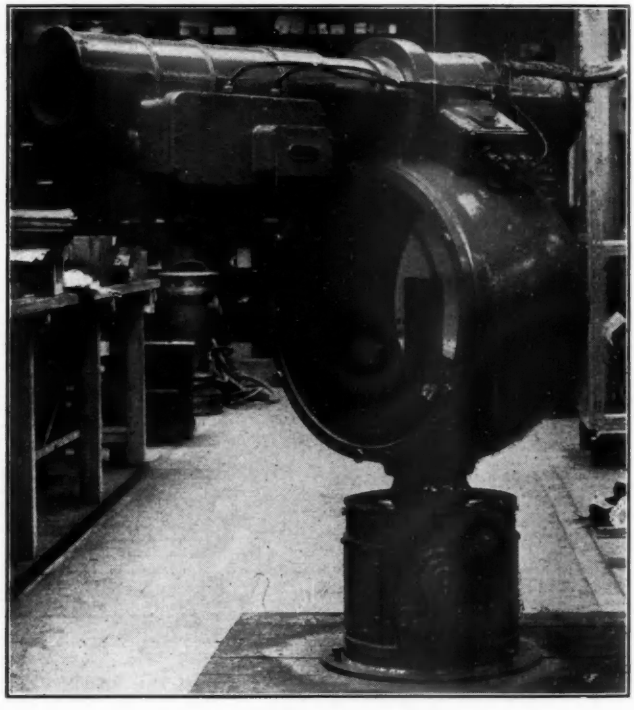


Fig. 7. Lighthouse fog detector.

is made possible by the Stone-Chance fog detector which was developed from the Trinity House patent and which replaces the constant watch for fog conditions. This ingenious device (illustrated in Fig. 7) emits a narrow and powerful beam of light and causes it to sweep the horizon at regular intervals. Some of the light scattered by fog is collected through a telescope and focused on to a photo cell so that the amount of scatter is measured. This is passed through various checking circuits to adjust the balance of the circuits according to fluctuating lamp output and cleanliness of the projecting cover glass etc. Smoke from passing vessels has no effect because the conditions have to be the same over a certain angle before the response is registered. The fog alarm is given when a predetermined intensity of scatter is received.

This heralds the automatic major lightstation and indicates how the advance of science is improving aids to navigation.

The author is indebted to Stone-Chance Ltd. for the drawings and photographs.

Book Reviews

Proceedings of the Seventh Hydraulics Conference, June 1958. Published by the State University of Iowa and edited by Arthur Toch and G. R. Schneider. Available from the Dept. of Publications, State University of Iowa, Iowa City, Iowa, U.S.A. Price $3.50.

The theme of this Conference is the agreement between the behaviour of full-scale hydraulics works and of small scale models designed to reproduce one or more aspect of the full-scale behaviour. The conclusions of the authors of the papers presented may be condensed into the statement that given accurate information and sufficient care in construction, working and measuring a model, accurate predictions of full-scale behaviour can be reached in nearly all cases.

Factors which in some cases need care and further study to allow the model results to be translated accurately to full-scale are the behaviour of the bed material in mobile bed models and variations in the relation between head and velocity in these models where the flow approaches the laminar condition or when gravity ceases to be the dominant force at work and surface tension becomes significant. Thus, while the mobile bed in a model is expected to be of the same general character as full-scale, some of the model bed levels may not be accurate and a model weir may give accurate predictions of full-scale flow at high and medium discharge but less reliable estimates for low discharge.

Among so many papers of practical importance it is difficult to make a selection but two papers in particular may be mentioned for the amount of hard and helpful information that they contain on a wide range of subjects. These are the paper by Mr. E. P. Fortson of the U.S. Waterways Experiment Station on a quarter-century assessment of experimental prediction in hydraulics and the one by Messrs. F. B. Campbell and E. B. Pickett on the work done during the last seven years in a subsection of the same Research Establishment on th study of full-scale performance compared with model performance in many hydraulic structures.

On the theoretical side Mr. Louis Landweber presents a scholarly account of the development of fluid mechanics from theoretical foundations in contrast to the experimental development of traditional hydraulics. He surveys the field from Euler's theoretical work through Laplace up to the newer developments of theory by Boussinesq and Prandtl leaving at the present time a complete theory of turbulence as perhaps the next milestone to be reached.

The value of these Proceedings is enhanced by printing the discussion and the author's reply immediately after each paper.

The Structural Use of Prestressed Concrete in Buildings (CP. 115: 1959). Obtainable from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1. Price 8s. 6d., postage extra

The first Code of Practice to deal with prestressed concrete, CP. 115, provides the authoritative guidance necessary for the general adoption of this form of construction. As with reinforced concrete in CP. 114, the scope of the new publication is limited to the use of prestressed concrete in buildings; but many of its recommendations have a much wider range of application. The Committee of experts who prepared the 44-page Code took particular care to represent good practice without placing restrictions on future development.

The recommendations covering the quality and strength of materials are based on general usage; but they may be extended to other suitable materials where sufficient is known of their properties. To achieve concrete of high quality and economy in construction, the design of concrete mixes is based on a specified requirement for strength. The standard of quality control recommended enable full advantage to be taken of measures which achieve greater uniformity in the production of concrete.

Permissible stresses in the steel and concrete and values for calculating losses of prestress are given for the design of beams, slabs, columns and composite and continuous construction—for the conditions arising during prestressing operations, during construction and under working loads. For beams and other flexural members a load factor against failure is defined as an additional requirement, and a method for calculating ultimate strength is recommended. Some guidance is provided on the use of secondary reinforcement and on the fire resistance of beams and slabs.

Other recommendations relate to the design, use and maintenance of prestressing equipment and to the materials and methods of grouting cable cavities. The practical aspects of concreting, formwork and treatment of prestressing steel are also dealt with. To assist in design, an appendix gives information on bond lengths obtained in the production of members with pretensioned steel.

CP. 115 was prepared by a committee convened on behalf of the Council for Codes of Practice by the Institution of Structural Engineers.

The Port of London Guide. Published by Wheatland Journals Ltd., 157 Hagden Lane, Watford, Herts. Price 25s. net, postage 1s. 6d. extra.

The 1959-60 edition of the Guide incorporates articles on such topical subjects as the first London Heliport, the Thames Navigation Service, which was inaugurated early this year, the Ship to Shore Telephone and Oil Interests in the Port. In addition, there is included a specially written, illustrated article commem orating the 50 Year Jubilee of the Port of London Authority.

The regular features of the Guide have been completely revised and comprise articles on the principal associations operating through the port such as shipping and forwarding agents, master lightermen and tug owners, master stevedores, public wharfingers, short sea traders, ships' chandlers and waterside manufacturers. The Wharf and other Directory sections dealing with imports and exports, bye-laws, dock labour, immigration service, port health and river fire services have been brought up to date.

Brown's Nautical Almanac 1960. Published by Brown, Son and Ferguson, Ltd., 52, 58 Darnley Street, Glasgow, S.1. Price 18s. 6d. net.

In the 83rd annual edition of the Almanac the Greenwich Hour Angle tabulations and the arrangement of the Ephemeris have been revised and rearranged to bring them into line with the new layout of the British and American Nautical Almanacs.

The Almanac is arranged in parts that are numbered for ready reference from I to VII, as follows: I, Astronomical data in daily use by navigators (with explanations); II, Nautical tables and method; III, Tide tables for home and foreign waters (the A.B.C. Tidal Constants for the British Isles have been revised and are now set in the same manner as the foreign ports); IV, Coastal courses and distances around the British Isles. The table of courses and distances around British Isles, and in the North Sea and English Channel have been thoroughly revised; V, Lights, buoys and beacons of the British Isles, including Eire and Channel Islands, followed by lights and beacons on the coast of Europe between Elbe and Brest; VI, Distance tables giving a world-wide coverage of total distances from the principal U.K. ports to all the main ports in the world; VII, Miscellaneous information.

The Almanac has been carefully edited and arranged to ensure accuracy, easiness of reference and that comprehensive brevity which is essential in nautical books for daily practical use.

Manufacturers' Announcements

New Dockside Crane

Stothert and Pitt Ld., of Bath, who first introduced the crank level luffing crane some 35 years ago, have succeeded once again in bringing entirely new ideas to dockside crane design.

This was shown when their latest model, the result of two years work by the firm's Research and Development Department, was demonstrated recently to a large number of port officials and engineers from home and abroad.

One of the greatest improvements has been effected by making the crane generally of tubular construction: this has resulted in exceptional cleanness of line, with the added advantages of lower wind resistance than that of the normal crane, and considerably less area requiring paint.

The basic model has a tail radius of only 10-ft. 6-in. and can be supplied as a 5-ton crane with a maximum radius of 80-ft. or as a 6-ton crane with a maximum radius of 70-ft. The only differences between the two variants lie in the jib length, the apex height and the hoist motor speed; the weight of both types, excluding load, however, remains the same 82-tons plus 12-tons of concrete ballast.

The requirements of British Standard 2452: 1954 have been adhered to, and in some cases exceeded, in the crane design, but cost and weight have been kept to a minimum.

The maximum wheel load for either size is 22 tons. This is based upon rail centres and bogie centres both of 13-ft. 6-in. The truck, which gives a portal clearance across, as well as along tracks, normally has four legs but can be fitted with three legs if the rail centres are 20-ft. or more.

A long pintle tube is attached to the underside of the superstructure and is supported by an oil immersed roller thrust and journal bearing. Side loads at the top of the tube are taken by three adjustable rollers which rotate inside a roller path. A spiral stairway is fitted inside the pintle tube and the driver is thus afforded total enclosure from the pintle platform to the cabin.

The jib is balanced in all positions and the arrangement of only one pulley spindle at the jib head eliminates bending stresses. A jib ladder, which would add weight and detract from the clean appearance, has been eliminated and it has been made possible to lower the jib head to the ground to give access to the jib pulley.

The system of luffing is a completely new departure from any method previously adopted by Stothert and Pitt, and employs a single centrally placed hydraulic ram of original design which operates the jib from a position in the apex. The luffing speed is variable up to 160 f.p.m. and controlled by the driver, and smooth acceleration and deceleration of the jib is guaranteed. Power required is small and the pump is driven by a $5\frac{1}{2}$-b.h.p. motor.

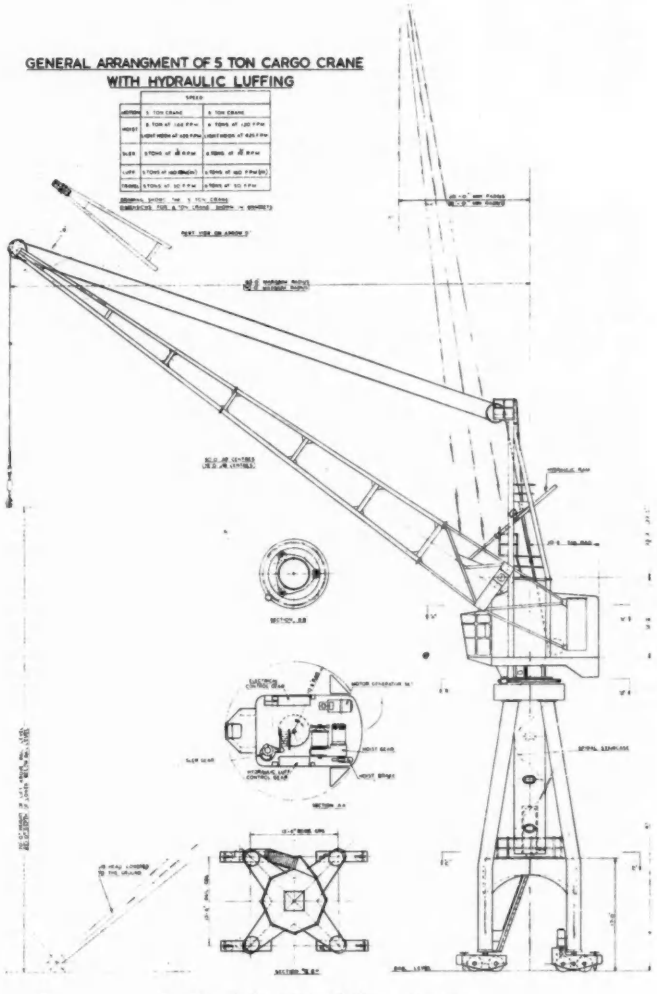
For hoisting, the crane employs the specially developed Mawdomatic system to drive the winch through totally enclosed double helical and spur gearing.

The electrical system provides the following main advantages:-

1. The hoisting and lowering speeds are variable and controlled by the driver.
2. Light loads can be hoisted at three times the speed of the maximum load, and intermediate loads at corresponding speeds, without the use of discriminating relays.
3. A similar characteristic is available when lowering, i.e., as the load is increased the maximum speed is decreased.
4. Automatically controlled lowering by regenerative breaking is employed on all lowering notches. An electro-magnetic brake is used only to hold the load in the 'off' position and for an emergency.
5. Control is obtained entirely on light current contactors. No contactors are used in the main D.C. circuit.
6. Whatever the load no heavy current surges are thrown on the supply line.

A D.C. solenoid controlled brake is fitted to the outside of the totally enclosed hoist gear box to which the electric motor is flange mounted.

The hoist gear design is such that little alteration is required to accommodate an alternative system of drive; thus a rectifier and D.C. motor may be fitted instead of the Ward-Leonard set and so may any one of the various A.C. drive systems either with or without change speed gears.



Sectional drawing of the new crane.

Using a 75 b.h.p. motor the hoisting speeds for the alternative working loads are 180 f.p.m. for 5-tons and 150-f.p.m. for 6-tons.

The slew pinion which engages with a segmental spur ring, integral with the roller path and bolted to the truck top, is driven from a motor of 15 b.h.p. through totally enclosed spur gearing running in oil. A fluid coupling is incorporated which effectively protects the motor and gear against overload and shock, and ensures a smooth and even drive. The brake is under the permanent control of a thrustor but its action can be intensified by a pedal-operated hydraulic gear with a limiting device to prevent excessive inertia loading. Slewing speed is $1\frac{1}{4}$ r.p.m.

The crane which travels at 50 f.p.m. is mounted on four two wheeled bogies each fitted with swivelling as well as rocking gear to minimise cross-racking and to enable curves to be negotiated. Each of two bogies is power driven by a 6 b.h.p. electric motor

through a fluid coupling and worm and spur gear to both wheels.

In the construction of the machinery house and drivers cabin the designers have repeated their departure from convention by using, in conjunction with galvanised steel, translucent resin-bonded glass fibre which gives soft uniform lighting.

The sides and front of the cabin are, in effect, large steel framed windows and windows are also supplied in the roof and floor to give the driver the maximum degree of visibility. "Rubber-glazed" safety glass is used throughout. Great care has been taken to ensure ease of operation, and "joy-stick" controls and an adjustable seat reduce driving effort to a minimum.

A wall crane is provided inside the house to facilitate maintenance, and is capable of lifting and swinging any of the machinery units through the back of the house which is fitted with jack knife doors.

Altogether a new conception has been brought to dockside crane design, and Stothert and Pitt have produced a model in which aesthetics are allied to that functional soundness over 130 years.

List of Sub-Contractors

Hydraulic Equipment	Keelavite Hydraulics Ltd.
Hoist Motor and Motor Generator Set for Hoist	Mawdsley's Ltd.
Electrical Control Equipment	Allen West and Co. Ltd.
Motors for Luff, Slew, Travel	Lancashire Dynamo and Crypto Ltd.
Brakes for Hoist, Slew, and Travel	Elliston, Evans and Jackson Ltd.
Machinery House and Driver's Cabin	Longwell Green Coach Works Ltd.
Fluid Couplings for Slew and Travel	Fluidrive Engineering Co. Ltd.
Ball and Roller Bearings	Skefko Ball Bearing Co. Ltd.
Taper Roller Bearings	British Timken Limited
Ropes	British Ropes Ltd.
Ferobestos Bearings	J. W. Roberts Ltd.
Spheroidal Graphite Iron Castings	John Williams and Sons (Cardiff)

New Tugs for Milford Haven

The development at Milford Haven of an ocean terminal for the petroleum industry requires a fleet of tugs capable of handling in the first instance, tankers of up to 65,000 tons d.w. and, in the future, very large vessels of 100,000 tons d.w. Four specially-designed tugs are being constructed by Richard Dunston, Ltd. for R. and J. H. Rea Ltd., a subsidiary company of William Cory and Son, Ltd., and the first of these, the "Stackgarth" is now on her way to her base.

It was decided that a small fleet of powerful tugs, each with a bollard pull of 20 tons at least, was preferable to a larger number of smaller craft, mainly in view of crewing costs which remain more or less constant whatever the power. In addition, the tugs should be designed for pushing and, because of the nature of the terminal, should also be available for fire-fighting. It has been argued that the towing gear necessary for a 20-ton bollard pull is too heavy and cumbersome to handle, but the substitution of wire and man-made fibre ropes for the manilla ropes used in the past makes the handling of heavier pulls no more difficult than used to be the case with a 12-ton pull.

The choice of the form of propulsion lay between single or twin screws, or a Kort nozzle, and geared or direct drive. The capital costs of the single open screw and the single screw Kort rudder were practically identical, whilst the cost of a twin screw installation was much higher. A Kort rudder would in this case enable a smaller engine to be used and its efficiency, especially at low speeds and small angles of helm, whether ahead or astern, gives greater manœuvrability than a single open screw and in certain cases, than a twin screw installation. As the tugs would be working in the open water of Milford Haven, there was little risk of damage to the nozzle. Maintenance costs might prove to be higher, but against this were the advantages gained in engine room layout by the reduction in length of the main machinery.

The main reason for selecting reduction-reverse gearing was that it simplified remote control from the bridge, which is an advantage when a vessel is manœuvring in confined areas. Within the context of the present problem it was decided to fit a Kort rudder with reverse-reduction gearing and a uni-directional engine.

Fire-fighting potential was required to be 3,000 gallons of water per minute at 100 lb. per sq. in., or 12,000 gallons of foam per minute. Foam compound capacity should be 4,000 gallons. Further, fire-fighting monitors were required 35-ft. above the water-line to facilitate projection of foam on to the deck of a tanker.

It was considered that the power to meet the fire-fighting requirement—about 400 h.p.—should not be derived from the main

Fig. 1. The "Stackgarth" undergoing trials.

engine; to do so might well interfere with the manœuvrability of of the tug while fighting fires. On the other hand, to install prime movers for fire-fighting pumps alone would be uneconomical. A workable compromise was reached by installing two 200 h.p. motors, each carrying half the load of fire-fighting duties, and each driving a 75-Kw. generator.

With such auxiliary power available, it was logical to use electric power for all services on board the tug. Thermovent heaters are installed throughout, and the galley range is also electric. When the fire-fighting pumps are in use, a third and smaller auxiliary set supplies power to operate the vessel; it can also be used while the tug is engaged on normal duties to avoid running large auxiliaries on low load.

The required height of the monitors caused both problems and opportunities. Immediately under the monitor platform, a closed wheelhouse, with almost the same scope of vision as a flying bridge, was located, and the space saved was used for accommodation. This is provided on the basis of a master, a chief engineer, a mate, and four hands. Officers have separate cabins, with twin berths in case a shift system is worked, while four two-berth cabins are provided for the crew. The surplus accommodation has been included to provide for ocean-going and salvage operations.

The main propulsion unit is a British Polar K47M engine, developing 1,300 b.h.p. at 300 r.p.m., driving through an M.W.D. 2 : 1 reduction gearbox to give a propeller speed under normal conditions of 150 r.p.m. The air intake of the engine is ducted direct from a section of the forward part of the funnel; the other forward section is an engine-room ventilator. This arrangement

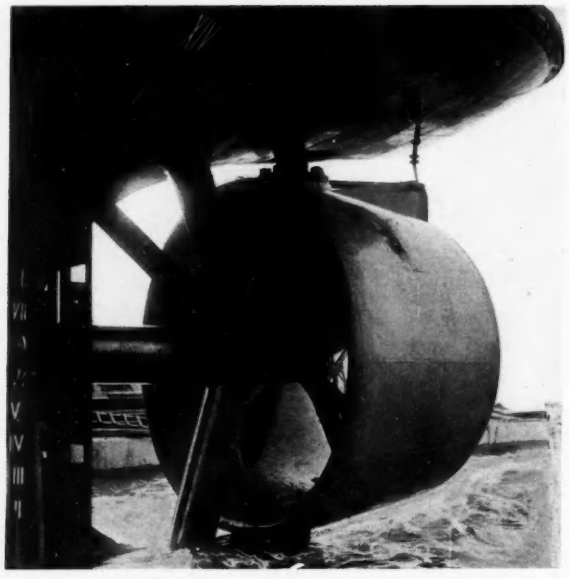


Fig. 2. Method of attachment of Kort rudder.

is beneficial, as otherwise all air entering the engine-room tends to be consumed by the engine.

Three auxiliary sets are installed. Two Rolls-Royce C63 FLM six-cylinder supercharged engines, of 230 b.h.p. at 1,800 r.p.m., are each directly coupled to a 75-Kw. generator with an extension shaft driving through a clutch to a two-stage Merryweather fire pump. No. 3 auxiliary set is a Russell Newbery type E4 engine of 66 b.h.p. at 1,000 r.p.m., with an air start motor. It is coupled through a centrifugal clutch to a 40-Kw. generator, normally able to meet all electrical requirements. This set can, however, run in parallel with either of the Rolls-Royce sets.

The Kort rudder requires a heavier stern frame and larger steering gear, Fig. 2 shows the method of attachment. A cast iron propeller was fitted both for reasons of economy and to prevent electrolytic action between the blades and the rudder.

To improve upward vision from the wheelhouse, curved glass panels, like those in observation coaches, have been fitted at each side. The engine-room casing has been extended some distance aft to make a lee for men handling towing gear in rough weather.

The " Stackgarth " has an overall length of 127-ft., a moulded breadth of 28-ft. 6-in. and a draught aft of 14-ft. 7-in. The vessel's block coefficient is 0.523. She carries a 16-ft. " Viking " aluminium lifeboat in Welin McLachlan Crescent davits and a 12-man R.F.D. liferaft. The bridge equipment includes Kent clear view screen, two compasses by Lilley and Reynolds, Ltd., Decca 303 radar, Pye Leadsman echo-sounder and a Clifford and Snell loudhailer. The MF/RT and VHF/RT wireless was supplied by Redifon Ltd.

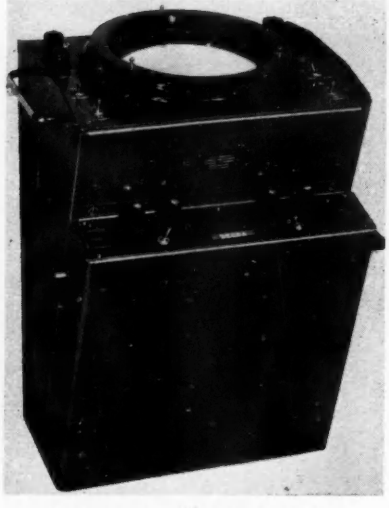
New Decca River Radar

At an international gathering of shipowners held in Rotterdam last month, Decca Radar Ltd. of London introduced their latest equipment, an entirely new River Radar.

This Company pioneered the use of river radar with the introduction of their type 214 in 1955 and, for the first time, made navigation of the Rhine and the inland waterways of Europe possible under all conditions of visibility, by day and night. The new radar, the Decca 215, has been designed in the light of operational and technical experience gained from over 300 installations of the original equipment. With higher power and a much larger scale presentation the 215 will shortly be in service on rivers and canals where radar fitted vessels have already demonstrated their ability to operate economically. Extensive programmes of fitting radar reflectors to bridge piers and buoys have already been carried out by navigation authorities, and on the Rhine police regulations have been altered to allow vessels with radar to continue their voyages in darkness and fog. An exacting specification to which radar must conform has also been introduced.

The 215 comprises a scanner unit, a combined transmitter/receiver and a display unit together with associated power supply. The units are compact and the radar may be readily installed in vessels of all classes and size.

The Display Unit is suitable for installation on a pedestal although it is normally fitted to a bulkhead or deckhead to conserve space in the wheelhouse. Seven closely spaced range scales ranging from 0.4 to 10-kilometres are provided on a 23-cm. radar screen, nautical and statute mile versions also being available. Each range may be off-centred by ½ a radius to provide increased warning ahead on the scale in use. The new 400-metre range provides a radar picture on twice the scale of the original Decca river radar and is suitable for very narrow waters or for the actual entry to a lock. The effective scale can be increased still further by means of a magnifier of high optical quality with a magnification of 1.7 times.



The compact 215 Display Unit.

The Transceiver, which is a compact bulkhead mounted unit and does not carry any controls, can be installed in any convenient position within 6-metres waveguide run of the scanner.

The Aerial is a horn fed tilted parabolic cylinder of 2-metres aperture which rotates at 24-r.p.m. The horizontal beamwidth is better than 1.2° at half power points and the side lobe level is extremely low, an essential feature in a radar for use in confined waters where very strong targets are viewed at close range. The aerial is normally installed on a short pole mast which may be of a retractable type where low bridges have to be negotiated.

The Power Supply for the radar and scanner is provided from a 420-watt motor alternator with separate voltage regulator. This equipment, which can be operated from any A.C. or D.C. ship's mains produces an output of 230-volts, 1,000-cycles for the radar and 110-volts D.C. for the scanner. For ships with inadequate power available a self-contained diesel power unit can be provided.

Rate of Turn Indicator. To replace the original Decca rate of turn indicator two further types have been designed to meet the agreed specification for such instruments isued by the Commission Centrale de la Navigation du Rhin. These provide the helmsman with an accurate and most sensitive heading reference which is essential when steering a vessel by radar. The two types have different degrees of sensitivity for use in vessels with slow or fast swinging rates.

Crane Lifting Tongs

The Somers Patent Automatic Lifting Tongs although designed for the Port of Manchester Warehouses Ltd. for use in their bonded tobacco warehouses, will be of considerable interest to others with similar handling and storage problems.

The warehouses are tall single-storeyed buildings, divided into large bays, each bay being served by an overhead gantry electric crane. The tobacco is packed in either rectangular cases or cylindrical casks, and most of the bays contain both types of package.

Prior to the installation of the lifting tongs, chain clams of various patterns had been used. The advantages of lifting tongs compared with orthodox chain clams are: (a) stacking speed can be maintained, or improved obviating the necessity of having men on the stacks, and (b) the fullest advantage can be taken of all space beneath the cranes.

The importance of these advantages may be gauged by the fact that, due to customs procedure, every package must be handled at least four times, and that the overall capital cost of providing accommodation for a cask of tobacco is about £15.

The length of both types of package is 3-ft. 10-in. ± 2-in. and as they are stacked with their axes parallel, accurate stacking is essential. To achieve this, two wire cables attached to the respective ends of the tongs, and led up to self-reeling drums mounted on either side of the travelling carriage of the cranes, control any tendency for the load to rotate about the axis of the crane rope.

The tongs constructed of alloy steel require a bare 4-in. end clearance, whilst

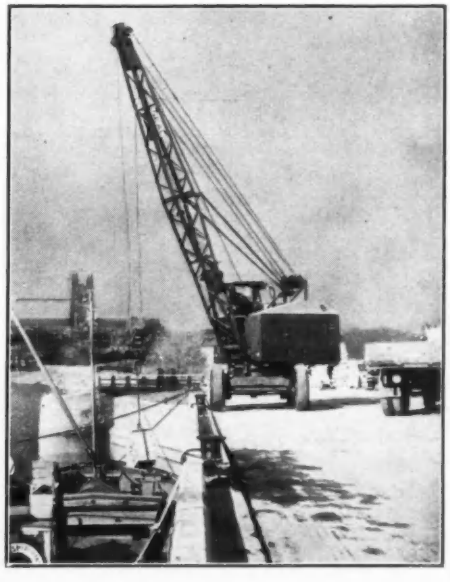
Cask lowered precisely into position of stack—note narrow margin of clearance.

retaining a generous safety factor when lifting 10-cwt. casks. The steel jaws consist of rectangular plates in which are inserted detachable studs, made from toughened steel and sharpened on the contact points. With these jaws it is possible to lift one 10-cwt. cask or two 5-cwt. cases at one time, safely and without damage to the timber, plywood or hardboard from which they are constructed. These studs are easily replaced when worn or blunted.

The prototype tongs have been in regular use for some months, and have proved most successful. A stacking height limited solely by crane clearance has been achieved, and with practice the crane drivers have been able to build orderly stacks up to 30-ft. high, entirely without the assistance of slingers. The Port of Manchester Warehouses Ltd. are equipping 60 of their existing cranes with them, and are specifying their use on all cranes now on order. They are constructed by Walter Somers (Materials Handling) Ltd., Hales Owen.

Mobile Cranes for China

As a result of enquiries made by the Chinese some months ago, R. H. Neal and Company Ltd., mobile crane manufacturers of Ealing and Grantham, announce the signing of contracts with the Chinese People's Republic worth more than £300,000. These contracts are for the supply of the Com-



One of the types to be supplied.

pany's standard mobile cranes, and the total order is believed to be the largest placed by the Chinese Authorities for this class of equipment anywhere in the west of Europe.

The cranes are of 6 and 15 tons capacity (British rating) and will, among other duties, be used in various ports.

New Channel Lighthouse

Construction is to start immediately on the first major Trinity House lighthouse to be erected for over 50 years. It will be situated on the shingle headland at Dungeness, Kent, and the contractors are Taylor Woodrow Construction, Ltd. The lighthouse, the first of its type in the country, will be fully automatic and will embody new technical and structural ideas, the result of months of investigation by Trinity House technicians in co-operation with Ronald Ward and Partners, the architects and engineers. The tower will rise 130-ft. from a white concrete base formed by a spiral ramp enclosing the machine room, which will contain stand-by generators, fog-signal equipment and the electrical controls. When there is a fog warning, the fog signal will be set in action automatically by the Trinity House fog detector, placed at the level of the public observation platform at the top of the ramp. The light for the main beam will be provided by a lamp of entirely new design, developed for lighthouse purposes by Trinity House engineers in conjunction with the A.E.I. Lamp and Lighting Co. While being little larger than a domestic light bulb, it gives out over 600,000 candle power, three times that of the existing paraffin light at Dungeness.

Circular Lifting Magnet

After extensive trials in steelworks and foundries during the past four years, tests on the new circular lifting magnet, the Liftmaster, have now been successfully completed. This magnet has certain definite advantages over the conventional design. Of welded construction and moisture proof, it offers unusual dependability and a greater pick-up for nominal

The Rapid Liftmaster magnet

diameter. The peripheral face is completely free from projections. For the moment its manufacture will be restricted to three sizes: 52-in., 62-in. and 72-in., although other circular lifting magnets manufactured by the Company, Rapid Magnetic Ltd., Birmingham 12, are available in a wide range of sizes from 2-in. to 76-in.

Repair System for Conveyor Belts

Only vulcanized repairs will bring belts back to manufacturing standards and a new technique and a new machine developed by Stenor Ltd., a member of the Firth Cleveland Group, reduces the time required for a small repair to less than 30 minutes. This repair will be absolutely flush with the cover, and will be as strong as the rest of the belt.

The Stenor Belt repair kit consists of a Weldbelt vulcanizer, and a set of tools and accessories neatly packed in a carrying case. Repairs can be carried out by one man, and the system is particularly recommended when the belt is operating outside, or in damp or arduous conditions. The Stenor system, which is approved by leading belt manufacturers and is of particular interest to conveyor maintenance engineers, makes possible a much simpler method of repairing damage, even holes right through the belt, and of repairing the edges of the belt.

The machine is supplied either unsupported for attachment to a bench, or on a movable stand, or with fittings for fixing to a girder.

Heavy-Lift Magnets

New type magnets designed specifically for the lifting of steel bars or railway lines were recently completed at the Bedford Works of Brookhurst Igranic Ltd. They are to be shipped to the Tata Iron and Steel Company's Jamshedpur mill in India.

Until a few years ago Tata's electrical control equipment was of American or German origin; now it is provided almost exclusively by Brookhurst Igranic, which supplies the company with control panels, breaks, limit switches, resistors and motor controllers. A member of the Metal Industries Group, this Company manufactures a wide range of magnets with lifts of up to 65-tons.

The new heavy-lift magnet

CLASSIFIED ADVERTISEMENTS

Rates 4s. per line (minimum 8s.); Box Number 2s. extra; Rate for single column inch is £2 per inch. Prepayment of classified advertisements is requested. Orders should be sent to Advertisement Department, "The Dock and Harbour Authority," 19, Harcourt Street, London, W.1. Telephone: PAD 0077.

FOR HIRE—Electric and Diesel Forklift Trucks for long- or short-term hire. Fork Lift Trucks for Hire Limited, 2 Abbots Road, London, E.6. GRAngewood 7101.

SHOT BLASTING in-situ by the 'on-site' experts. Organic and Inorganic Coatings applied. Anything, anywhere at competitive rates. Darnall Shotblasting Co., Ltd., Doctor Lane, Sheffield, 9. Telephone 42896.

APPOINTMENT VACANT

YOUNG GRADUATE CIVIL ENGINEER REQUIRED by old-established firm dredging contractors. Previous experience not essential. Employment on permanent basis with full staff benefits for right man. Write Box No. 226 The Dock and Harbour Authority, 19 Harcourt Street, London, W.1.

FOR SALE

WICK HARBOUR TRUST

ELECTRICAL PUMPING PLANT AT DRY DOCK

The Wick Harbour Trustees following the closing of the Dry Dock, invite offers for this Electrical Pumping Plant comprising a VICKERS-GILL VERTICLE SPINDLE SINGLE STAGE PROPELLER PUMP A.C. MOTOR. AUTO-TRANSFORMER STARTER and AUTOMATIC CONTROL EQUIPMENT New 1952

Prospective offerers may inspect the Pumping Plant by arrangement with the Harbour Master (Telephone Wick 30), and must satisfy themselves as to the state of the plant which, is not warranted.

The buyer, at the buyer's expense will be required to remove the Plant to satisfaction of the Harbour Trust.

Sealed offers marked "Dry Dock Pumping Plant" to be lodged with the undersigned on or before 31st December 1959.

H. GEORGESON,
Harbour Secretary.

WICK, Caithness.

DAVIES INVESTMENTS LIMITED
BANKERS
Continue to offer 7¼% on sums £20—£500
(withdrawal on demand) with extra ½% on each £500 unit
Details from Investment Dept. DH.
DAVIES INVESTMENTS LTD.
DANES INN HOUSE, 265 STRAND, LONDON, WC2

TENDERS

TIMARU HARBOUR BOARD

NEW DREDGER

Tenders are invited for the construction and delivery in New Zealand of a diesel and electric bucket hopper dredger of 1,000-tons hopper dead weight for the Timaru Harbour Board, New Zealand.

Tender documents may be obtained on or after 21st December, 1959, from the offices of the board or from the Consulting Engineers, Sir Bruce White, Wolfe Barry & Partners, 1, Lygon Place, Westminster, London. S.W.1, on payment of the sum of £1,000 sterling which will be returnable on receipt of a Bona Fide tender, on which point the Board will be the sole arbiters.

Tenders which shall be submitted in triplicate shall bear on the envelope the words "Tender for Dredger for Timaru", one copy being delivered to the Secretary, Timaru Harbour Board Office, Timaru, New Zealand and the other two to Sir Bruce White, Wolfe Barry & Partners not later than 12 noon (local time) on 31st March 1960.

The tender documents may be inspected prior to purchase at the offices of the Board or of the Consulting Engineers.

COMMISSIONERS FOR THE PORT OF CALCUTTA

60 TONS TWIN SCREW CRANE VESSEL

INVITATION TO TENDER

Tenders are invited from experienced firms for the construction, supply and delivery afloat at the Port of Calcutta in accordance with the Specification, the Contract Drawings and the Conditions of Contract complete in all respects for the service intended of:—

ONE TWIN SCREW STEAM 60 TONS CRANE VESSEL

so as to reach the Chief Mechanical Engineer, Calcutta Port Commissioners, 8 Garden Reach Road, Kidderpore, Calcutta 23, not later than 1700 hours I.S.T. on the 7th day of March 1960 and the Consulting Engineers not later than 1130 hours G.M.T. on the same day.

Tender Documents may be obtained either from the Chief Mechanical Engineer, Calcutta Port Commissioners or from the Consulting Engineers, Messrs. Rendel, Palmer & Tritton, 125 Victoria Street, Westminster, London, S.W.1 on deposit with the Treasurer, Calcutta Port Commissioners, 15 Strand Road, Calcutta or with the Consulting Engineers, of the sum of £2,000 or Rs 26,667/- as "Earnest Money" which will be refunded to unsuccessful tenderers on the award of the tender being made, and in the case of successful tenderer this amount will be adjusted towards the security deposit. The cost of Tender Documents, which will not be refunded amounting to £3 or Rs. 40/- per copy should be paid together with the Earnest Money.

Tenders in sealed envelopes, endorsed on the outside "TENDERS FOR NEW 60 TONS CRANE VESSEL" are to be submitted in triplicate of which two copies are to be sent to the Chief Mechanical Engineer and the remaining copy to the Consulting Engineers.

Tenders will be opened at the offices of Messrs. Rendel, Palmer & Tritton and the Chief Mechanical Engineer shortly after the closing time referred to above and any tenderer who wishes to be present at the time of opening may do so.

Quotations from the Tenderers must be firm and remain open for a period of 16 weeks from the closing date.

The Calcutta Port Commissioner do not bind themselves to accept the lowest or any tender and reserve the right to accept or reject any tender without assigning any reason.